A STUDY OF THE RELATIONSHIPS IN FINANCIAL PERFORMANCE, ORGANIZATION SIZE, BUSINESS CLASSIFICATION, AND PROGRAM MATURITY OF SIX SIGMA SYSTEMS

A dissertation

Presented to

The College of Graduate Studies and Professional Studies

College of Technology

Indiana State University

Terre Haute, Indiana

In Partial Fulfillment

of the Requirements for the Degree

Technology Management Ph.D.

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by

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August, 2010

Keywords: Six Sigma, Financial, Technology Management, SME, Manufacturing

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ABSTRACT

United States companies are facing increased competition as business continues to grow globally. This is true for large companies and small-to-medium enterprises (SMEs), as well as manufacturing and non-manufacturing organizations. To remain competitive, organizations need to improve product value, technology, customization, service, and turnaround time while reducing costs and increasing innovation. Many large manufacturers have turned to Six Sigma as a quality method to guide improvement efforts. Reported results have been significant in terms of cost reduction and the bottom line.

Leaders in Six Sigma efforts have been Motorola, General Electric (GE), Allied Signal, Honeywell, and Ford. These manufacturers are all large in size. SMEs have not implemented Six Sigma to the same degree as large organizations due to limited resources and capacity to successfully deploy and sustain Six Sigma. Similarly, manufacturing led the way and non-manufacturers are now beginning to implement Six Sigma systems. As more SMEs and non-manufacturers launch Six Sigma efforts, new challenges are encountered. Quality authorities have found Six Sigma to have a positive impact on the bottom line financial performance of large manufacturing organizations. However, it is unknown if there is a positive impact to the financial performance of SMEs and non-manufacturers implementing Six Sigma. This study examined the relationships in financial performance, organization size, business classification, and program maturity for Six Sigma systems. A sample of 606 individuals were surveyed based on a distribution list generated with membership from the American Society of Quality (ASQ),

iSixSigma organization (iSixSigma, n.d.), and the NIST (National Institute of Standards and Technology)/MEP (Manufacturing Extension Partnership) organization (NIST, 2009). Regression was utilized to evaluate relationships between financial performance, organization size, business classification, and program maturity.

The relationships between financial performance, organization size, business classification, and program maturity were not significant. Additionally, the majority of respondents rated their organizations at a program maturity level 4. The study results showed no apparent relationship between Six Sigma program maturity, program maturity level, organization size, and business classification.

DEDICATION

This dissertation is dedicated to my husband, David, and to our sons, Matthew, Weston, and Braddon. You have always supported my ongoing education efforts. I love you all very much and thank you for your patience and encouragement.

ACKNOWLEDGMENTS

I would like to thank my dissertation committee for their participation and guidance during the process of completing this dissertation. My deep gratitude goes to Dr. John Sinn, my committee chair, for his selfless commitment to guiding and supporting my work. I would also like to thank committee members Dr. Ronald Woolsey and Dr. Michael Hayden for their guidance in the statistical analysis. Additionally, I wish to thank Dr. Jeff Ulmer and Dr. Royce Ann Martin for their participation and encouragement.

I wish to thank others outside the dissertation committee. Particularly, those who assisted in the development of the study survey, including Justin Gilbert, Rich Berg, Brad McEnroe, Steve Casey, Steve Yahr, Ted Mattis, Karl Palmer, JoEll Hashemi, Maureen Cochran, Aaron Bialzik, and Dr. Renee Surdick. I would also like to extend a thank you to the survey respondents. Additionally, I wish to thank colleagues who offered their support during the dissertation process, specifically Dr. Katherine Lui, Dr. Wendy Dittmann, Dr. Michael Galloy, William Kryshak, and Susan Greene.

Finally, I would like to give a huge thank you to my husband and three sons for their continued support, sacrifices, and encouragement throughout the dissertation process.

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CHAPTER 1

INTRODUCTION

Overview

New human, business, and technology demands are requiring businesses to focus on quality principles and methods to deliver high quality performance (Conti, Kondo, & Watson, 2003). Global competition requires companies to offer value, high-technology products, customization, improved service and parts support, short production runs and fast turnaround time to remain competitive (ASQ, n. d.). Quality discipline and methodology are enabling organizations to align quality with rapidly changing and increasing customer expectations. Six Sigma is a quality method that has been proven by large manufacturers such as Motorola, General Electric (GE), and Allied Signal to improve their operations and competitiveness. Additionally, large companies are increasing their dependence on small-to-medium enterprises (SMEs) to be suppliers as they streamline their operations to reduce costs. Many large companies that have successfully implemented Six Sigma are requiring supplier SMEs to also implement Six Sigma to improve quality and reduce costs and prices.

The first decade of the 21st century is moving quality from manufacturing to non-manufacturing (Conti et al., 2003). Characteristics present in manufacturing processes also exist in non-manufacturing processes (Evans & Lindsay, 2005). As a result, Six Sigma can be applied to a wide variety of transactional, administrative, and service areas. Examples of non-manufacturing industries utilizing Six Sigma techniques include healthcare, hotel, restaurant, retail, and banking. Additionally, Six Sigma within manufacturing organizations has moved from the manufacturing floor to other departments such as purchasing, finance, human resources, and marketing. There is general agreement that 50 percent or more of the total savings opportunity in an organization can be found outside of manufacturing.

Successful examples of high performance through the use of quality discipline and Six Sigma methodology are limited for SMEs and non-manufacturing organizations. This study examined large organizations and SMEs in manufacturing and non-manufacturing businesses with Six Sigma systems to determine if there were relationships in financial performance, organization size, business classification, and program maturity. Chapter 1 defines the purpose and need for this study, as well as a statement of the problem, research questions, and hypotheses. Additionally, assumptions, limitations, and definitions of terminology are provided.

Statement of Purpose

The purpose of this study was to examine the financial performance of Six Sigma companies and analyze the relevance of the financial performance comparing large companies versus SMEs, manufacturing versus non-manufacturing organizations, and program maturity. SMEs and non-manufacturing organizations are under increasing pressure to implement quality programs such as Six Sigma to remain competitive with large manufacturers, other SMEs, and other non-manufacturers worldwide. However, SMEs do not have the same resources available as large organizations in terms of time availability, investment dollars for training, and dedicated resources to focus on Six Sigma efforts. This causes SMEs to hesitate or question the viability and sustainability of implementing Six Sigma. Further Six Sigma originated in manufacturing with companies such as Motorola and GE. However, Six Sigma has not been implemented as extensively in non-manufacturing organizations. There is a need to understand the relationship of Six Sigma and the financial performance of SMEs versus large organizations, non-manufacturers versus manufacturers, and program maturity. Based on the literature review, a study comparing organization size, business classification, and program maturity for Six Sigma systems does not exist. Results of the study will be used to understand the relationships in financial performance, organization size, business classification, and program maturity.

Statement of Problem

The problem for this study was to determine the relationships in financial performance, organization size, business classification, and program maturity of Six Sigma systems.

Research Questions

Based on the review of literature and the statement of the problem, questions related to Six Sigma systems surfaced from the work of authorities in quality related fields. Research questions included,

1. What are the relationships inherent in organization size, business classification, and organizational financial performance as related to Six Sigma system maturity?
2. What is the relationship of Six Sigma program success relative to organizational financial performance, organization size, business classification, and program maturity of the Six Sigma system?

Hypothesis Statement

Research questions were further developed into the hypotheses. Hypotheses 1-3 relate to program maturity for research question one and Hypotheses 4-5 relate to financial performance for research question one and research question two.

Hypothesis 1: Program Maturity for Organization Size and Business Classification

H_{01}: $\beta j = 0$. There is no statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 2: Program Maturity Factors for Organization Size and Business Classification

H_{02}: $\beta j = 0$. There is no statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 3: Program Maturity for Years of Implementation

H_{03}: $\beta j = 0$. There is no statistically significant relationship between program maturity and years of implementation.

H_{a3}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and years of implementation.

Hypothesis 4: Financial Performance for Organization Size and Business Classification

H_{04}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a4}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 5: Financial Performance for Program Maturity Level

H_{05}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

H_{a5}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

Statement of Assumptions

Assumptions of the Study

There was an assumption that a sufficient number of large companies and SMEs in manufacturing and non-manufacturing businesses would respond to the survey tool. It was also assumed there would be a sufficient number of SMEs and non-manufacturers utilizing Six Sigma systems. Additionally, the study assumed that Six Sigma program efforts were consistent between organizations.

It was assumed that participating organizations would have accessible financial data for use in this study. Additionally, it was assumed that companies participating in the study would voluntarily disclose accurate financial results consistent with generally accepted accounting practices and economic factors would not skew the data reported. Also, there was an assumption that program maturity factors and financial measurements, gross profit margin and operating margin, would accurately translate to the degree of impact in the analysis.

Assumptions of the Statistical Analysis

Assumptions for regression analysis include, independent or predictor variables are independent of each other, distribution of values for the dependent variable are normal, variance of the dependent variable distribution must be equal, and the relationship between dependent and independent variables must be linear (Norusis, 2005). Regression also assumes that the dependent variable is ratio or coded nominal/ordinal and independent variables are either interval or ratio.

Statement of Limitations

Limitations of the Study

The information collected for analysis was limited by the fact that it is self reported, so reporting practices may be somewhat variable. Survey respondents may have been restricted from participating or reporting financial information due to organizational policies. More than one respondent from a single company may have participated. Certified Six Sigma respondents may have come from organizations where Six Sigma was implemented for more years and the program maturity was more advanced. Additionally, the organizations used in the study may have been limited by the number of Six Sigma systems at SMEs and non-manufacturing organizations. Another limitation was the potential existence of the Hawthorne Effect (Leedy &

Ormrod, 2005), as employees may have increased productivity in response to the increased amount of attention received during the initial phases of Six Sigma systems. Finally, the sample was not entirely random due to the method used to create the survey distribution list, which limited the ability to generalize the survey results.

Limitations of the Statistical Analysis

Limitations of the statistical analysis were to have an adequate sample size (Norusis, 2005). If groups vary widely in sample size and smaller groups have larger variances, the chance of rejecting the null hypothesis when it is true, a Type I error, increases. If groups vary widely in sample size and larger groups have smaller variances, the Type II error or chance of rejecting the null hypothesis when it is false increases.

Statement of Terminology

Black Belt. Full time Six Sigma expert responsible for leading Six Sigma projects (Evans & Lindsay, 2005, p. 268).

Business Classification. Businesses can be classified in many ways. For purposes of this study, classifications will include manufacturing and non-manufacturing. The North American Industry Classification System (NAICS) is the standard for Federal statistical agencies. NAICS "classifies business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the United States business economy." Manufacturing is one of the classifications (NAICS, 2007).

DMAIC. The Six Sigma process steps of Define, Measure, Analyze, Improve, and Control (Evans & Lindsay, 2005, pp. 488-492).

Financial Performance (FP). Measurements of profitability. For this study, financial performance will be measured using gross profit margin and operating margin (Business Link, n.d.).

Green Belt. Functional employees trained in introductory Six Sigma methods who work on projects part time (Evans & Lindsay, 2005, p. 269).

Gross Profit. "Calculated as sales minus all costs directly related to those sales. Costs can include manufacturing expenses, raw materials, labor, selling, marketing, and other expenses" (InvestorWords, 2007).

Gross Profit Margin. Also, gross profit as a percent of sales. "What remains from sales after a company pays out the cost of goods sold. To obtain gross profit margin, divide gross profit by sales. Gross profit margin is expressed as a percentage" (InvestorWords, 2009).

Lean. A process philosophy with three purposes. The purposes are to eliminate wasted time, effort, and material, provide customers with make-to-order products, and reduce cost while improving quality (George, 2002).

Master Black Belt. Full time Six Sigma expert responsible for Six Sigma strategy, training, mentoring, deployment, and results. Master Black Belts are the highest level Six Sigma experts in an organization (Evans & Lindsay, 2005, p. 268).

NPV. Net Present Value. "The present value of an investment's future net cash flows minus the initial investment. If positive, the investment should be made unless an even better investment exists, otherwise it should not" (InvestorWords, 2009).

Operating Income. "A measure of a company's earning power from ongoing operations, equal to earnings before deduction of interest payments and income taxes. Also called operating profit or earnings before interest and taxes" (InvestorWords, 2007).

Operating Margin. Also, operating income as a percent of sales. "Operating income divided by revenues, expressed as a percentage" (InvestorWords, 2009).

ROI. Return on Investment. "A measure of a corporation's profitability, equal to a fiscal year's income divided by common stock and preferred stock equity plus long-term debt. ROI measures how effectively the firm uses its capital to generate profit" (InvestorWords, 2007).

Six Sigma. A quality method providing a structured, disciplined project approach to problem solving and breakthrough results. It is statistically equal to 3.4 or fewer dpmos (Evans & Lindsay, pp. 132-135).

SME. Small-to-medium enterprise. Manufacturing Institute and National Association of Manufacturers define small and medium manufacturers (Murphy, 2006). Small companies employ 500 employees or less. Medium companies employ 2,500 employees or less.

Summary

This study examined large organizations and SMEs in manufacturing and non-manufacturing businesses with Six Sigma systems to determine if there were relationships in financial performance, organization size, business classification, and program maturity. Chapter 1 defined the purpose and need for this study, as well as a statement the problem, research questions, and hypotheses. Additionally, assumptions, limitations, and definitions of terminology were provided.

CHAPTER 2

REVIEW OF LITERATURE

Overview

Literature related to Six Sigma and large manufacturing organizations was readily available. However, literature specific to Six Sigma studies comparing the relationships in financial performance, organization size, business classification, and program maturity was limited. Chapter 2, the Review of Literature, provides a definition of Six Sigma, as well as an overview of literature related to financial performance, organization size (large and SME), business classification (manufacturing and non-manufacturing), and program maturity. Additionally, the chapter describes reviews of similar studies, previous research, and opposition to Six Sigma.

Six Sigma Definition

Six Sigma is defined as a business improvement approach, statistical measure, management system, and an operational philosophy. As businesses focus on achieving competitiveness through providing consistently reliable products and services to their customers, Six Sigma has become a powerful initiative to pursue. According to Evans and Lindsay (2005), "Six Sigma can be described as a business improvement approach that seeks to find and eliminate the causes of defects and errors in manufacturing and service processes by focusing on outputs that are critical to customers have a clear financial return for the organization (p. 132)."

The term Six Sigma is a statistical measure equal to 3.4 or fewer errors or defects per million opportunities (dpmo). Greater sigma quality levels mean fewer defects and less variation, translating to lower cost. Standard Six Sigma levels represent business process capability as detailed in Table 1.

Table 1

Six Sigma Levels.

Sigma Level	dpmo	Yield
6	3.4	99.9997%
5	233	99.977%
4	6,210	99.379%
3	66,807	93.32%
2	308,537	69.2%
1	690,000	31%

Note. Adapted from *Lean Six Sigma* by George, 2002, p. 16. Copyright 2002 by The McGraw-Hill Companies, Inc. Reprinted with permission.

The Six Sigma concept gets its foundation from a combination of core concepts from quality leaders and other quality methods. Motorola is credited with pioneering Six Sigma and invented the Six Sigma quality process in 1986 (Evans & Lindsay, 2005). Six Sigma is a registered trademark and service mark of Motorola, Inc. (Huesing, 2008). Stepping back historically, Gauss defined a standard normal distribution as having a mean of zero and a variance of one. The distribution was called a bell-shaped curve because the graph of its probability density resembled a bell. Six Sigma was originally designed to identify and prevent defects in manufacturing processes. The concept of Six Sigma contends that strong relationships exist between product nonconformities or defects and factors such as product yield, reliability, cycle time, inventory, and schedule. As the number of defects increases, the sigma value decreases.

Sigma, "σ" the population standard deviation, is a measure of variability or dispersion of observations and the square root of the population variance (Pyzdek, 2003). It is also statistical measure of process variability. Variation is considered the number one enemy of quality, yields, and costs (Huesing, 2008). Quality can be achieved by attacking and minimizing variation. Variation occurs when a process does not produce consistent, predictable results over time. Variation exists in all processes and can lead to defects and, subsequently, dissatisfied customers.

Six Sigma is a process quality goal and a process capability technique (Pyzdek, 2003). Traditionally, a process was considered capable if it fell within a plus or minus three sigma variance, translating to a process yield of 99.73 percent, assuming normality. Later, capability was refined and the variance spread tightened to a minimum acceptance criterion of four sigma, then six sigma from the process mean. Motorola changed quality discussions from quality levels measured in percent, parts-per-hundred, to parts-per-million. The company pointed out that modern technology was so complex that modern business required near perfect quality levels and could no longer tolerate quality levels that had previously been acceptable.

Bill Smith, a reliability engineer at Motorola, and Mikel Harry, a principal staff engineer at Motorola, created a course, Design for Manufacturability, to improve process capability so no more than 3.4 defects per million opportunities would be created during the design process (Huesing, 2008). This was the first step in formalizing today's design for Six Sigma (DFSS). The Six Sigma process initially involved six steps, and Mario Perez Wilson developed a five step M/PCpS (Machine/Process Characterization Study) method for manufacturing (Advanced

Systems, 2008). Ideas from these steps eventually came together to become the Six Sigma processes of DMAIC (Define, Measure, Analyze, Improve, Control) and DMADV (Define, Measure, Analyze, Design, Verify).

Deming was also instrumental in furthering the ideas of Six Sigma with the System of Profound Knowledge (Huesing, 2008; Evans & Lindsay, 2005). Deming's ideas related to Six Sigma specifically include,

- Appreciation for a system. Understanding that all components of a business or system are related and must work together to be effective.
- Understanding of variation. Knowledge of statistical theory and variation.
- Theory of knowledge. Philosophy of the nature and scope of knowledge, basis for knowledge, and reliability of claims of knowledge.
- Psychology. Understanding of people, interactions between people and situations, as well as leaders, systems, and how people are motivated.

From Motorola's view, "Six Sigma was built on Total Quality Management (TQM)" and "evolved to be about business management, value creation, and improvement for the customer and the shareholder" (Huesing, 2008).

A basic Six Sigma graph involves the normal bell-shaped curve, the grand average or target, and three standard deviations to the right and left of the grand average. The theoretical basis for Six Sigma levels related to variation is illustrated in Figure 1.

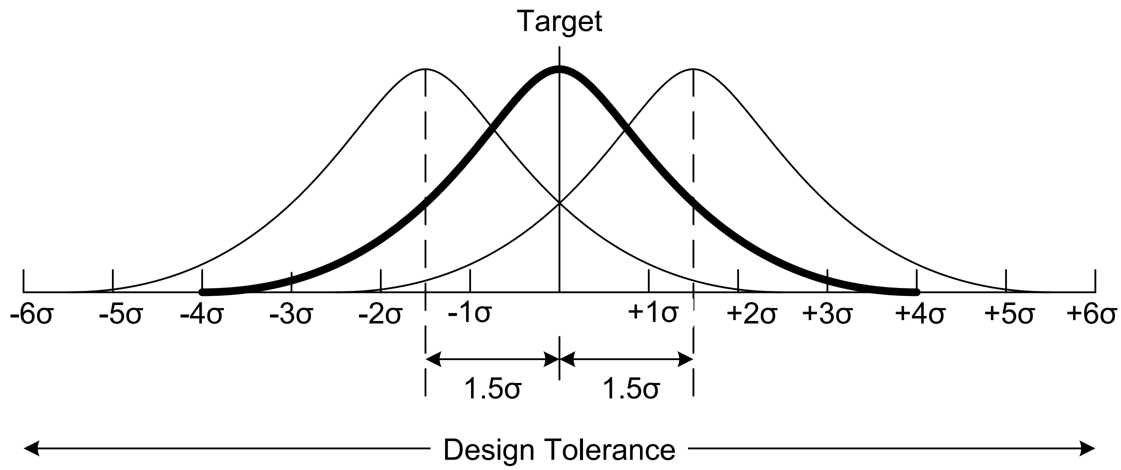

Figure 1. Theoretical basis for Six Sigma levels centered in a normal distribution. Adapted from The Management and Control of Quality by Evans & Lindsay, 2005, p. 482. Copyright 2005 by South-Western. Reprinted with permission.

Motorola developed the graph in Figure 1 in the context of manufacturing specifications because field failure data suggested that processes drifted an average of 1.5 sigma or standard deviations. It is important to allow for a shift in the distribution because no process can be maintained in perfect control. Evans and Lindsay (2005) state that many common statistical process control (SPC) plans are based on sample sizes which allow for a noticeable shift detection of two standard deviations. Regardless of the shift, it is possible for a process to fall within the design tolerance and achieve six sigma quality. Figure 1 illustrates quality levels with the shift included.

Length of time for data collection is also important in terms of the 1.5 sigma drift (Breyfogle, 2003). Short-term data is considered free of special causes while long-term data can contain both special and random cause variation. Additionally, long-term processes can exhibit more variation than short-term processes due to factors such as tool wear, change of operators, or a change in raw material lots. As a result, if short-term data is collected, then long-term performance can be estimated by subtracting 1.5 from the short-term sigma. Conversely, if long-term data is collected, then short-term capability can be calculated by adding 1.5 to the long-term sigma. Breyfogle states, “A classical Six Sigma definition is that world-class organizations are those considered to be at six sigma performance in the short term or 4.5 sigma in the long term. Average companies are said to show a four sigma performance” (p. 189).

George (2002) defined Six Sigma as a management system used by business leaders to achieve top performance and benefit the business, customers, and shareholders. De Feo (2001) is in agreement with this view, describing Six Sigma as an operational philosophy shared by customers, shareholders, employees, and suppliers. The operational philosophy and methods provide a structured, disciplined project oriented approach to problem solving and breakthrough results. The basic method used is DMAIC which is an acronym for the problem solving steps of Define, Measure, Analyze, Improve and Control, as detailed in Table 2 (Evans & Lindsay, 2005).

Table 2

Six Sigma DMAIC Process.

Acronym	Term	Definition
D	Define	Define the problem and scope the project
M	Measure	Measure internal processes to better understand relationships between process performance and customer value
A	Analyze	Apply statistical analysis to determine the root cause
I	Improve	Generate solutions to resolve the problem and improve performance
C	Control	Institute standards, tools and training to maintain improvements

The concept of Six Sigma was pioneered by Motorola in the mid-1980s as an approach to measuring product and service quality (Evans & Lindsay, 2005). Implementation of Six Sigma at General Electric (GE), driven by former CEO Jack Welch, brought significant attention to the concept, making it a popular approach to quality improvement. In the mid-1990s, Larry Bossidy, the former CEO of Allied Signal, learned of Six Sigma from Jack Welch and further promoted the approach. Six Sigma has gained a significant amount of credibility because of its acceptance at major firms such as Allied Signal which merged with Honeywell, GE and Motorola. GE is a recognized benchmark for Six Sigma systems. Key learning's discovered by GE and observed by Jack Welch included waste reduction, capacity creation, cycle time reduction, improved forecast reliability, and a better understanding of customer needs. Motorola experienced unprecedented growth and sales, and launched the Motorola University to offer Six Sigma training to other organizations (Breyfogle, Cupello, & Meadows, 2001).

Individuals within organizations are trained and certified to lead or participate in Six Sigma projects, including Master Black Belts, Black Belts, and Green Belts. Typical companies launching Six Sigma can anticipate that one percent of their workforce will need to be trained as full time Black Belts (Keller, 2005; George, 2002).

Financial Impact of Six Sigma

Literature related to the financial impact of Six Sigma discussed the impact in terms of individual projects and the overall bottom line. Individual Six Sigma projects may be selected on the basis of cost, ROI or NPV. However, the literature showed that strategic planning from an organizational system perspective can provide significant bottom line results. This section of the literature review discusses individual projects, costs, strategy, and bottom line results for Six Sigma systems.

The ultimate goal of Six Sigma is higher profits through reduced waste, better throughput, and improved customer satisfaction (Martin, 2001). It is set apart from other quality improvement techniques by the use of quantified data and statistics to evaluate and measure how quality driven process changes affect profitability. A higher process sigma means fewer defects which deliver lower production related costs and greater profitability.

Bisgaard and Freiesieben (2004) stated that the ultimate quality award is improved bottom line profitability. Cost of poor quality (COPQ) is a common criterion for selection and evaluation of Six Sigma projects. Six Sigma companies who do not have Six Sigma system experience high COPQ, costing between 25 percent and 40 percent of revenues to fix problems (De Feo, 2001). Money spent eliminating defects and root causes should be amortized and viewed as an investment and not a cost. Jack Welch contended that Six Sigma saved GE more than three-quarters of a billion dollars within three years (Allan & Davenport, 2009). Other Six Sigma success stories include Eastman Kodak who saved over $100 million on Six Sigma projects, Raytheon who reduced the amount it spends fixing problems from 25 percent to 1 percent, and Lockheed Martin who saved $14,000 per jet produced (Breyfogle et al., 2001).

Business strategy is important in terms of aligning with an effective strategy to plan, implement, and sustain Six Sigma methods to create shareholder value (George, 2002). Phases include initiation, project and resource selection, as well as implementation, sustainability, and evolution. Initiation includes engagement of executive management, development of two to five year financial and performance goals, creation of a vision, establishing an organizational infrastructure and training of top leadership. Activities are project based and project selection requires looking at the ROI and the net present value (NPV). Other authorities agree with the need to calculate and measure the ROI.

As metrics and money are important pieces to implementation strategy, selection of metrics and reporting are vital to Six Sigma system success (Breyfogle et al., 2001). It is useful to tie project benefits to money as a unit of measure to establish a common metric across all projects. The rationale is that money is easier to interpret and less controversial than a quality metric. Tracking a combination of hard and soft savings is recommended. Hard savings show tangible monetary benefits, while soft savings show cost avoidance and indirect impact.

According to Snee and Hoerl (2003), Black Belt projects typically save $250,000 or more and Green Belt projects save $50,000 to $75,000. To uncover the full impact of Six Sigma efforts, these results need to be evaluated relative to a company's overall cost structure and revenues. Further, the bottom line impact can be evaluated by looking at sales, variable and fixed costs, and profit.

Once projects are selected, Breyfogle et al. (2001) believe significant processes should be baselined to help determine bottom-line benefits. The bottom-line benefit should include baseline metrics and charts with calculations. Baseline metrics should include COPQ to determine the value of a project to the organization versus the cost of doing nothing. Breyfogle et al. (2001) state that it is a big leap to assume quality improvements will correlate to profit improvements. Project savings alone don't address the long-term impact of Six Sigma methods, so a balanced approach is important.

The views of Bendell and Marra (2002) agreed with Breyfogle et al (2001). In the Six Sigma model, reduced cost does not mean reduced quality. Six Sigma concentrates on the reduction and control of variation and defects to reduce cost and increase customer satisfaction. When customer satisfaction increases, sales increase through increased customer value, resulting in new customers and increased profits. Profit is gross revenue less cost. Gross revenue is revenue from both new and existing customers.

Six Sigma methodology and tools are a way to eliminate customer Critical to Quality (CTQ) issues and dramatically improve cost, quality and responsiveness (George, 2002). Measurements include increased Return on Invested Capital (ROIC), reduced manufacturing lead time, increased Work in Process (WIP) inventory turns, reduced manufacturing overhead and quality cost, increased gross profit margins, increased operating margins, and higher Six Sigma quality levels. A value proposition for Six Sigma describes current and future percent revenue, including a percent cost reduction for revenue, direct costs, cost of goods sold, gross profit, operating profit, marketing, and other general accounting values.

Six Sigma may also be combined with lean methods. George (2002) provides a high level guide to strategize, justify, and implement a Lean Six Sigma program, stressing that adopting Lean Six Sigma is a choice, not a mandate. George rationalizes using Lean Six Sigma to achieve better results in a shorter time period, using techniques and measurements to provide ROI information and data. In addition, it is important to understand and calculate the value proposition to convince executives and shareholders of the payback from investments made in the lean Six Sigma effort. George states, "Lean Six Sigma--unlike other improvement methodologies--is clearly tied to shareholder value creation--an endeavor that must be led by the CEO or COO (p. xiii)." NPV is used to help select priority projects, where a high NPV is an indicator that improvement will likely translate into shareholder value. NPV can be applied to a variety of measurements at many levels. The techniques are similar to those found by authors such as Breyfogle et al. (2001) and Pyzdek (2003).

There are numerous measurements for analyzing financial performance. It is important to choose financial measures that are reflective of business results. Key standard metrics for measuring profitability are gross profit margin and operating margin (Business Link, n. d.). Gross profit margin measures how much money is made, taking the direct costs of sales into account. Operating margin takes overhead into account, without interest and tax payments. Other key standard metrics include net profit margin and return on capital employed (ROCE). Net profit margin includes interest and tax payments, which may vary dependent on geographic location. ROCE looks at how well money invested in a business is performing compared with other investments such as putting money in a bank. In a discussion with William Kryshak, Associate Professor of Finance at the University of Wisconsin-Stout, it was determined that gross profit margin and operating margin measurements would be most appropriate for this study to enable a true financial comparison between organizations regardless of size or business classification.

Organization Size

Historically, Six Sigma was successfully developed and utilized in large organizations such as Motorola, GE, and Allied Signal. However, large companies have increased dependence on small-to-medium enterprises (SMEs) to be suppliers of parts as operations are streamlined to reduce costs and prices (ASQ, n. d.). This has put pressure on SME suppliers to reduce prices and costs as well.

The United States Small Business Administration defines small business as not to exceed 500 employees (ASQ, n. d.). Similarly, the Manufacturing Institute and the National Association of Manufacturers (Murphy, 2006) define small and medium manufacturers, SMEs, as small companies employing 500 employees or less and medium companies employing 2,500 employees or less. SMEs play a key role in the American economy by contributing 40 percent to the total value of United States production, maintaining eight million employees or 60 percent of United States manufacturing employment. SMEs also contribute 62,000 exporters, with many more supplying other exporters, and provide more innovations per employee than large manufacturers.

The need for quality methods such as Six Sigma is becoming more urgent with increasing competition and higher customer expectations. Companies need to maintain a competitive edge in everything they do to achieve complete customer and shareholder satisfaction (De Feo, 2000). Keller (2005), author of *Six Sigma Deployment* and *Six Sigma Demystified*, found as Six Sigma becomes more prevalent in Fortune 500 companies, many SMEs are asking if Six Sigma deployment is right for them. According to Keller, the benefit of an improved bottom line is the same for small as well as large organizations, but small businesses face different challenges. For example, small business tends to have fewer human resources and less up-front capital for quality initiatives (ASQ, n. d.). However, upper management commitment and accessibility can be stronger and internal communications more straightforward. Large companies with Six Sigma systems may spend hundreds of thousands of dollars to train Six Sigma experts. Smaller companies fear that Six Sigma may deplete financial resources long before meaningful ROI is realized.

SMEs experience the same competitive demands to operate and sustain a successful business as large organizations, including quality improvement and cost reduction. Six Sigma has been proven by large organizations such as Motorola and General Electric (GE) to improve their operations and competitiveness. Logically, SMEs should be able to take advantage of the benefits of Six Sigma systems similar to large companies. Six Sigma can be employed by any organization, regardless of its size, to improve performance (Gupta & Schultz, 2005). Similar to large companies, making Six Sigma work for small business requires balancing the benefits of Six Sigma systems with investment in training. As small businesses have limited budgets with no margin for failure, Six Sigma must work on the first implementation. Further, system costs can be prorated to accommodate the smaller organization size. For example, Ideal Aerosmith is a small company that successfully implemented Six Sigma with guidance from experienced outside help. Efforts resulted in improved teamwork, incorporation of the methodology into the corporate culture, 30 percent improvement in on-time deliveries, 25 percent improvement in labor efficiencies, and five percent improvement in profits in one year.

A study of 280 ASQ *Quality Digest* readers was conducted in 2001 (Dusharme, 2001). The majority of respondents with Six Sigma systems agreed that the methods significantly improved job and customer satisfaction. However, the study found 60 percent of respondents were part of large organizations with more than 10,000 employees. One reason cited was that Six Sigma required dedicated resources such as Black Belts, which were unavailable to smaller organizations. Additionally, larger companies had more bureaucracy and, as a result, more potential areas for improvement. The study concluded that while Six Sigma was worth the investment, it was not practical for small companies due to the resource requirements.

A study in the United Kingdom (UK) compared SMEs with Six Sigma systems with SMEs without Six Sigma systems (Kumar & Antony, 2009). The study found that Six Sigma firms experienced significant improvement in operational performance metrics such as scrap rate, cycle time, on-time delivery, and yield. The Six Sigma firms also experienced significant improvement in strategic performance metrics, including sales, profit, and customer satisfaction when compared to non-Six Sigma SMEs. The study concluded that critical differences in quality practices between Six Sigma and non-Six Sigma SMEs affected business performance.

Business Classification

Businesses are classified in a number of ways. The North American Industry Classification System (NAICS) is the standard for Federal statistical agencies. NAICS classified business establishments for Federal statistical activated related to the United States economy. For purposes of this study, classifications included manufacturing and non-manufacturing. The United States Department of Labor, Occupational Safety and Health Administration, defines manufacturing as, "Establishments engaged in the mechanical or chemical transformation of materials or substances into new products (OSHA, n.d.)." Non-manufacturing is identified by the following classifications, (1) agriculture, (2) mining, (3) construction, (4) transportation, communication, electric, gas, and sanitation services, (5) wholesale and retail trade, (6) finance, insurance, and real estate, (7) services, and (8) public administration (NAICS, 2007).

Global competition requires manufacturers to offer value, high-technology products, customization, improved service and parts support, short production runs and fast turnaround time to remain competitive. Historically, Six Sigma techniques have been applied to a wide variety of manufacturing processes to enable continuous improvement and competitiveness in the global economy (Breyfogle et al., 2001). Six Sigma systems enable organizations to focus on the big picture and drill down when appropriate. Manufacturers have achieved significant benefits when their measurement and improvement activities progressed from single products to manufacturing processes. Six Sigma provides a means to expose the hidden factory for rework and helps quantify the cost of doing nothing. Traditional success stories in manufacturing businesses include Motorola, GE, Allied Signal with Honeywell, Ford, and Xerox (Evans & Lindsay, 2005).

According to Dr. Armand Feigenbaum, there has been increasing global emphasis on economics, change, and improvement (Conti et al., 2003). New human, business, and technology demands are requiring businesses to focus on quality principles, methods, and disciplines to deliver high quality performance. The first decade of the 21st century is moving quality from the original product manufacturing industry to business services. Quality principles and methods are increasingly being used in healthcare, education, technology, medicine, government, and public administration. New systematic quality discipline and methodology is enabling organizations to align quality with changing and increasing customer expectations. However, successful non-manufacturing examples of high performance through the use of quality discipline and methodology are still limited. As a result, a major task for all businesses is to further understand, clarify, and focus quality practices and have a clear basis to effectively apply them.

Application of quality methods to non-manufacturing functions and organizations is not new. Tenner (1991) says that a process improvement model can extend the concept of continuous quality improvement from manufacturing to non-manufacturing areas. Manufacturing is unique in that customers are isolated from production, outputs are tangible, and operations are highly repetitive. Non-manufacturing differs in that customers are typically directly involved, a service may be intangible or unique, and some non-manufacturing processes may be repeated infrequently. Manufacturing and non-manufacturing are similar in that every product and service can be described and measured by performance characteristics. Continuous improvements and the development of quality methods extend beyond manufacturing and offer a competitive advantage to all businesses. Further, quality techniques are applicable to all functions within an organization, including information systems, marketing, finance, engineering, administration, and research and development.

A 2001 survey revealed a wider application of Six Sigma than expected with respondents from non-manufacturing areas such as document control, shipping, sales and marketing, purchasing, and customer service (Dusharme, 2001). While the application of Six Sigma may not be clear for non-manufacturing, respondents in the survey achieved significant reductions in cost, time, and waste. It is important for leaders to study other organizations within and outside their business class with Six Sigma systems. Organizations must look beyond manufacturing to understand and successfully apply the underlying concepts.

In the healthcare industry, for example, Six Sigma may provide significant benefits for hospitals, medical professionals, and patients. An example of Six Sigma success in healthcare was presented from a new study at CHEST 2007, the 73rd annual international scientific assembly of the American College of Chest Physicians (ACCP) (American College of Chest Physicians, 2007). The study showed that Six Sigma performance improvement techniques may help hospitals decrease hospitalized patient mortality, length of hospital stay, and healthcare costs. In addition, Six Sigma systems could improve compliance with Joint Commission (JCAHO) Core Measures related to community-acquired pneumonia (CAP). In addition to patient decreased mortality, improved processes by eliminating non-value-added process steps and reducing defects and variation. Based on this study, Six Sigma can lead to improved quality care and cost savings in healthcare organizations.

Program Maturity

Program maturity has been utilized for determining recipients of the Malcolm Baldrige award (NIST, 2009) and the Software Engineering Institute (SEI) maturity level award for the software Capability Maturity Model (CMM) (CMU/SEI, 1994). Each of these awards requires organizations to document and demonstrate maturity in their processes. Recipients of these awards become models of success for other organizations. A similar award does not exist for Six Sigma. However, literature exists which describes factors related to program maturity that may contribute to Six Sigma success.

Authorities in quality agree that a fully implemented Six Sigma program requires a strategic approach that is driven and supported by top management. Additionally, Six Sigma should be deployed at every level throughout an organization to be fully successful. Several key factors contribute to an effective Six Sigma system, including (Evans & Lindsay, 2005):

- Committed leadership from top management. For many companies, Six Sigma may require a major cultural shift, which requires close involvement of top leadership.

Firsthand involvement during training, Six Sigma reviews, or site visits helps integrate Six Sigma into an organization's culture.

- Integration with existing initiatives, business strategy, and performance measurement. Companies should justify Six Sigma and integrate Six Sigma goals and efforts within the organization's mission and vision, focusing on customers and the bottom line.
- Process thinking. Mapping business processes is a key activity in Six Sigma efforts and provides a disciplined approach to problem solving, as well as information gathering and analysis.
- Disciplined customer and market intelligence gathering. The ultimate goal is to make improvements in products and services that are important to the customer.
- A bottom-line orientation. Six Sigma projects must have a positive impact on the bottom line, producing savings or revenues in the short- and long-term.
- Leadership in the trenches. Technical and non-technical employees at all levels need to work together as a team to solve problems using the DMAIC approach. It is important to include employees with and without Six Sigma belts.
- Training. Appropriate, real-world training raises employee awareness and provides skills in the practical use of statistical and problem-solving tools.
- Continuous reinforcement and rewards. Organizations with Six Sigma systems have changed performance measurement and reward systems. Executive incentives and employee promotions are tied to Six Sigma goals and progress. Also, savings may be pooled at the business unit level and shared with Six Sigma team members.

George (2002) agreed with Evans and Lindsay and identifies five critical success factors. Critical success factors include a customer concentric culture, positive financial results, management engagement, resource commitment, as well as an infrastructure that integrates Six Sigma projects into the real work of the organization. Enabling a sustainable program involves creating a culture that incorporates learning and provides a well defined infrastructure to engage executives, train and coach employees, and track results. Pyzdek (2003) agreed with George stating that failure to provide the required infrastructure is a major reason why quality improvement efforts have failed in the past. Key messages are that everything starts with the customer, the infrastructure for cultural change is more powerful than planned strategy, and project decisions should be based on potential NPV impact. Management engagement is required for sustained improvement and CEO goals should be translated to frontline projects and coordinated with the organization's resources. A Six Sigma system should build on the strategic plan and start with communication in the form of a kick off and launch of the program by the CEO and executive management, tying in profit objectives.

A recent example of Six Sigma success was Crown Equipment Company where Six Sigma enabled savings of nearly $1.5 million (Chircop, 2008). Quality had been part of Crown Equipment's philosophy since its inception in 1945. The company was committed to lowering costs and maximizing productivity, implementing quality programs such as lean manufacturing and TQM. Recently, however, Crown used Six Sigma to improve processes, reduce scrap and gas usage, and fine-tune operations. The company has 18 certified Green Belts and 15 Black Belts in its North American manufacturing facilities. Green Belt efforts saved $1.2 million and Black Belts saved $285,000. Training for the first 12 Green Belts totaled 2,400 hours, but the company calculated it saved more than $500 per hour for each hour spent in training.

Basic themes for Crown's success included teams assigned to well-defined projects with a direct impact on the bottom line, statistical training at all levels, and extensive training in advanced statistics and project management for key Green or Black Belt staff, DMAIC is used for problem solving, and the management environment supports Six Sigma project initiatives as a business strategy. Attention was given to Six Sigma systems at organizational and project levels. According to John Daeger, quality engineering manager at Crown's New Bremen headquarters, results indicated Six Sigma was the strongest improvement tool a company could use.

Unsuccessful Six Sigma efforts share common problems. Issues include minimal leadership at the corporate and business unit levels (Snee & Hoerl, 2003). Additional issues are related to resources and include poor selection of employees for Master Black Belt (MBB) and Black Belt certification and responsibilities, less than fulltime MBB and Black Belt resources, and inadequate allocation of resources assigned to projects. Other issues include a poor project selection process and lack of a reward and recognition system to support the Six Sigma work.

While there are a number of factors related to successful Six Sigma systems, program maturity may have a significant impact. He (2009) suggests a method and general framework to assess a Six Sigma program's maturity. The framework was developed by researching and analyzing 106 companies with Six Sigma systems in China. The research was based on a survey and face-to-face interviews with Six Sigma champions, black belts and green belts. The research found that it was important to establish Six Sigma maturity assessment criteria to enable creation of organizational benchmarks for the evaluation of Six Sigma deployment performance, strengths, weaknesses, best practices, gap analysis, and improvement. The maturity criteria were developed utilizing Malcolm Baldrige criteria and Motorola's corporate quality system review (QSR) guidelines. A team of 24 people from industry and academia decided on seven categories of core values including leadership, strategy, customer focus, infrastructure, project management, Evaluation/Motivation, and business results. A 1,000-point scale was developed and companies were divided into four categories with poor being a score of less than 400, marginally qualified a score of 400 to 600, qualified a score of 600 to 800, and excellent more than 800.

He's maturity rating scale for the assessment ranged from 0 to 5, including very poor (0), poor (1), fair (2), marginally qualified (3), qualified (4), and excellent (5). A very poor performance level indicated no systematic Six Sigma project selection procedure or management involvement and most project failures were due to poor project selection. A poor performance level indicated no systematic Six Sigma project selection procedure with management involvement, low alignment with organizational strategy, and project failures due to poor project selection. A fair rating indicated a documented Six Sigma project selection procedure with some management involvement, use of Voice of Customer (VOC) in project selection, but inadequate management participation leading to inappropriate scope or objectives. Marginally qualified ratings indicated a documented Six Sigma project selection procedure with involvement of management, utilizing VOC and voice of business in the selection process. A qualified performance level indicated a well defined and documented Six Sigma project selection procedure based on business strategy with strong management involvement, utilizing VOC and voice of business, and alignment with SMART (specific, measurable, achievable, relevant, time bound) objectives. Finally, an excellent rating indicated a well defined and documented Six Sigma project selection procedure, very strong management involvement, full utilization of VOC and voice of business in project selection, evidence that the procedure is followed with continuous improvement, and project scopes in line with SMART objectives. The number of years since implementing Six Sigma was also recorded. A total maturity score was calculated and results were then categorized as strengths or opportunities for improvement. He stated that the ROI for conducting the assessment would be the result of improving the Six Sigma deployment process. More than 20 Chinese companies adopted He's criteria for self assessment as of the publication date.

Review of Similar Studies and Previous Research

A similar Ph.D. level dissertation was "A Study of the Impact of Six Sigma on Firm Performance: Theoretical Analysis and Empirical Investigation" by Xingxing Zu at Clemson University (2005). This dissertation explored the value of Six Sigma in improving performance by comparing Six Sigma with traditional TQM programs for 226 United States manufacturers. Results showed that Six Sigma and TQM were complementary and together led to improved quality and business performance. Suggested future research was needed to explore how to integrate Six Sigma and TQM practices to maximize the benefits of both on business performance.

Another related dissertation was "An Empirical Study of the Impact of Six Sigma Methodology on Organization Financial Performance in the United States" by Flora Ayeni at Regent University (2004). The purpose of the study was to compare the impact of TQM and Six Sigma on the financial performance measures of sales, percent of gross profit to sales, percent of operating income to sales, and stock price. A sample of 45 manufacturing and non-manufacturing firms that had used TQM and switched to Six Sigma was studied. Financial data was collected for three years prior to and three years after Six Sigma implementation. Results showed a statistically significant influence by method and business classification on net income and no statistical significance for return on assets or stock price. Future suggested research included looking at company size and comparing the financial performance of large, medium, and small companies.

Kuo-liang Lee at Cleveland State University (2003) completed a dissertation entitled "Critical Success Factors of Six Sigma Implementation and the Impact on Operations Performance." The objectives of this research were to develop a successful model of Six Sigma implementation and explore the impact after implementation. The model identified major success factors critical to Six Sigma implementation. The impact after implementation looked at operational cost, customer satisfaction, and quality culture change for large manufacturers and SMEs. Results of 106 respondents indicated leadership and statistical tool usage were critical success factors. Significant results were realized in operations, customer satisfaction and the quality culture. Results of the study indicated no difference in the success of Six Sigma in large companies when compared to SMEs. Suggested future research included comparing different industries, better defining and analyzing Six Sigma implementation success and looking at a length of time greater than three years.

Yewande Adeyemi (2004) at the University of Pittsburgh completed a thesis entitled "An Analysis of Six Sigma at Small vs. Large Manufacturing Companies." The objective of the study was to analyze the performance of large and small manufacturing companies that deployed Six Sigma to determine whether the long-term benefits were worth the investment costs for smaller manufacturers. The study used quantitative and qualitative methods and evaluated reported revenue, costs, and savings at five Fortune 500 companies with successful Six Sigma programs. A data collection instrument was used to study small manufacturers. Results showed challenges for all organizations in deploying Six Sigma regardless of size. Additionally, small companies had the capacity to implement Six Sigma programs successfully and the benefits outweighed the costs. Future research with a larger sample size was suggested, particularly in highly populated regions where large and small manufacturers were plentiful. Additional research could include examining reasons for companies choosing not to implement Six Sigma. Also, conducting research over a longer period of time was suggested as many companies need more time to sustain valuable results. Other areas of future research include looking at staffing levels, amount of investment, and other industries.

Cua (2000) at the University of Minnesota completed a dissertation entitled "A theory of integrated manufacturing practices: Relating total quality management, just-in-time and total productive maintenance." The study examined implementation of Integrated Manufacturing Practices or the interrelationship between Total Quality Management (TQM), Just-in-Time (JIT), and Total Productive Maintenance (TPM). Case studies at three manufacturing plants and survey data from 163 manufacturing plants were included. The study utilized hierarchical multiple regression analysis, discriminant analysis, and structural equation modeling. Results showed a positive association with manufacturing performance and higher levels of implementation. The results indicated that manufacturing plants should implement practices that are both socially and technically oriented to best support performance improvement.

Goffnett (2007) completed a dissertation entitled "High performance quality management systems and work-related outcomes: Exploring the role of audit readiness and documented procedures effectiveness." The purpose of the study was to examine certified quality systems in the automotive industry and determine whether critical quality management factors significantly affect quality management system (QMS) audit readiness or work outcomes. Malcolm Baldrige criteria were used as main system factors, including leadership, strategic planning, customer and market focus, measurement, analysis, and knowledge, workforce focus, and process management. Organizational outcomes and results included financial and market outcomes, workforce job satisfaction, workforce engagement, and product and service quality customer focus. Perceived audit readiness was related to ISO/TS procedures and preparedness. The study determined that leadership and process management were critical prediction factors to work outcomes, followed by Human Resources. Audit readiness was not a mediating factor, but did significantly affect work process outcomes. Suggested future research included incorporating new technologies or measures, testing interactions as well as the main effects, testing potential leading or lagging relationships with leadership, and including the global perspective.

Review of Opposition to Six Sigma

While Six Sigma has experienced success, there are views opposing the value and benefits of Six Sigma in general and for SMEs in particular. Schneiderman (2006) does not totally agree with Six Sigma for the following reasons. First, the Six Sigma metric is in question as it is not simple to understand or effective in determining customer satisfaction. Additionally, the value of 3.4x10-6 typically has a long term drift of 1.5 sigma in most process means, which yields a true value of 4.5 sigma. Additionally, Six Sigma has been touted as having a bottom line impact, however, the numbers are self reported and may be unsubstantiated. In this case an independent audit would be valuable.

A study by Celerant Consulting (Celerant, 2005) found that Six Sigma was the top initiative manufacturers were most likely pursue. The increased interest came from a better understanding of Six Sigma's track record and its greater success as compared to other initiatives. In the past three years, approximately 25 percent of all companies surveyed undertook a Six Sigma project and 41 percent more large companies than SMEs undertook Six Sigma projects. The overall perceived Six Sigma project success rate was 81 percent, with 89 percent for large companies and 69 percent for small companies, indicating less success for small companies.

Weigang (2005) stated that while companies such as Motorola and Bombardier have been very successful implementing Six Sigma, long-term success cannot depend on Six Sigma or any one management concept alone. Further, he states that most companies develop Six Sigma strategies focusing on short-term profits and ignore the consequences of activities for employees and their environment in the long term. Today, major market changes combined with a lack of innovation can lead to lost market share and profit. Wiegang says that people resources are the most important organizational success factor, especially for medium sized companies. Further, the triple constraint of cost, time, and quality must be considered as well as customer loyalty. A process model called Visual Process Management which incorporates the Five S’s, standardization, fun during work, process thinking, and process goals with measurement criteria is vital. Weigang maintains that without Visual Process Management at the basic level, Six Sigma projects at the macro level and strategic projects at the mega level will fail. A structure combining integrated profit management with Visual Process Management is needed to increase productivity and enable long-term success.

Allen and Davenport (2009) agreed with Weigang, stating that organizations cannot rely on Six Sigma alone, but must implement an array of process management tools. This is necessary to embrace disruptive innovation and adapt changes for new products and processes to remain competitive. Further, critics have said that Six Sigma stifles innovation, is a program and not a philosophy, is limited in success, and produces substandard bottom-line results in terms of stock price. The systematic approach may work for customer relationships and production, but may impede innovative thinking. As a program, employees not assigned to Six Sigma projects may be excluded. Ideally, all employees should be involved in quality and process improvement. Six Sigma may avoid radical change for fear of failure. Specifically, changes to information systems and technology infrastructure are typically not incorporated into Six Sigma projects. There are also mixed results to the bottom line in terms of stock price. While studies have shown firms outperforming competitors based on Standard & Poor’s (S&P) results, a random study of 58 companies showed 91% underperformed compared to the S&P 500. However, there is agreement that Six Sigma implementations experience a wide variability of adherence to the methodology, so comparisons may be invalid. Finally, Allen and Davenport state that there is solid evidence that Six Sigma can be successfully integrated with other methods such as TQM, lean, and ISO 9000 and enable breakthrough innovation.

Summary

Literature specific to Six Sigma studies comparing the relationships in financial performance, organization size, business classification, and program maturity was limited. Chapter 2, the Review of Literature, provided a definition of Six Sigma, as well as an overview of literature related to financial performance, organization size (large and SME), business classification (manufacturing and non-manufacturing), and program maturity. Additionally, the chapter described reviews of similar studies, previous research, and opposition to Six Sigma.

CHAPTER 3

METHODOLOGY

Overview

Chapter 3, Methodology, provides the statement of the problem, preliminary findings based on authorities, research questions, and hypotheses for this study. Additionally, the chapter discusses the Type I error selection, population and sampling, variables to be utilized, research instrumentation, survey development procedures and data collection, as well as reliability. Finally, Chapter 3 discusses the statistical analysis to be used and related assumptions.

Statement of Problem

The problem statement for this study was to determine the relationships in financial performance, organization size, business classification, and program maturity of Six Sigma systems.

Preliminary Findings

Preliminary findings based on previous dissertations and the opinions of authorities raise questions regarding the relationships in financial performance, organization size, business classification, and program maturity of Six Sigma systems. Questions to study based on findings of authorities from the literature review are described in Table 3.

Table 3

Questions to Study Based on Findings of Authorities.

Question	Authority
What is the relationship between financial performance and organization size (large versus SME)?	Adeyemi (2004), ASQ (n.d.), Evans & Lindsay (2005), Gupta & Schultz (2005), Keller (2005), Kumar & Antony (2009). Pyzdek (2003)
What is the relationship between financial performance and business classification (manufacturing versus non-manufacturing)?	Ayeni (2004), Breyfogle et al. (2001), Conti et al. (2003), Dusharme (2001), Evans & Lindsay (2005)
What is the relationship between financial performance and program maturity?	Chircop (2008), Evans & Lindsay (2005), George (2002), He (2009), Pyzdek (2003), Snee & Hoerl (2003)

Research Questions

The problem for this study was to determine the relationships in financial performance, organization size, business classification, and program maturity of Six Sigma systems. Based on the review of literature and the statement of the problem, questions related to Six Sigma systems surface from the work of authorities in quality related fields. Research questions included,

1. What are the relationships inherent in organization size, business classification, and organizational financial performance as related to Six Sigma system maturity?
2. What is the relationship of Six Sigma program success relative to organizational financial performance, organization size, business classification, and program maturity of the Six Sigma system?

Hypothesis Statement

Research questions were further developed into the hypotheses. Hypotheses 1-3 relate to program maturity for research question one and Hypotheses 4-5 relate to financial performance for research question one and research question two.

Hypothesis 1: Program Maturity for Organization Size and Business Classification

H_{01}: $\beta j = 0$. There is no statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 2: Program Maturity Factors for Organization Size and Business Classification

H_{02}: $\beta j = 0$. There is no statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 3: Program Maturity for Years of Implementation

H_{03}: $\beta j = 0$. There is no statistically significant relationship between program maturity and years of implementation.

H_{a3}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and years of implementation.

Hypothesis 4: Financial Performance for Organization Size and Business Classification

H_{04}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a4}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 5: Financial Performance for Program Maturity Level

H_{05}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

H_{a5}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

Type I Error (Alpha) Selection

The financial results of Six Sigma systems are important in terms of choosing to implement and sustain Six Sigma. If the results of this study determined that organization size, business classification, and program maturity have an effect on financial results (the dependent variable), a company could use this information to make decisions on implementation, training, organizational structure, tools, human resource initiatives, and project selection. If the results indicated that organization size, business classification, and program maturity do not have an effect on financial results, then decisions about implementation, training, organizational structure, tools, human resource initiatives, and project selection would not be impacted.

If the null hypotheses stating that there is no difference in financial results for organization size, business classification, and program maturity is rejected, and indeed there is no difference, a Type I error would occur. As a result, a decision could be made by a SME or non-manufacturing organization to invest in Six Sigma. The cost to the company in this situation would be the expense of launching or continuing to invest in Six Sigma. This cost in terms of funding, time, training, and labor could potentially not improve processes, products, or the company's bottom line finances. Additionally, efforts towards Six Sigma with a realization and need to stop the efforts later in time could cause confusion and reduced morale for employees. In this case, there would be a false confidence in Six Sigma system decisions as well as project selection and related training efforts.

If the null hypothesis stating that there is no difference in financial results for organization size, business classification, and program maturity is not rejected and there is a difference, a Type II error would occur. A decision could be made by a SME or non-manufacturing organization not to invest in Six Sigma. The cost to the company in this situation would be the expense of waste, continued higher operating costs, poor employee morale, as well as missed opportunities for better serving customers or producing products. The company could potentially go under as it could be ineffective when competing with other companies taking advantage of Six Sigma in the global economy.

Depending on the investment and financial impact to the bottom line, both Type I and Type II errors could mean loss of dollars. Since both types of errors could be costly, the percent error, $\alpha = .05$, is acceptable for this analysis.

Population and Sampling

The initial population included large organizations and SMEs in manufacturing and non-manufacturing within the United States with Six Sigma systems as identified in cooperation with members of the American Society of Quality (ASQ), the iSixSigma organization, and NIST (National Institute of Standards and Technology)/MEP (Manufacturing Extension Partnership). The iSixSigma membership initially identified 312 organizations with Six Sigma systems in the United States (iSixSigma, 2004). The organization size or business classification of these organizations was not specified. An additional 15 NIST/MEP organizations were identified as utilizing Six Sigma methods (NIST/MEP, 2010). ASQ members participating in the Six Sigma forums, members employed by the identified Six Sigma organizations, members identified through searches with interest or expertise in Six Sigma with publicly disclosed contact information, and members self-identifying their willingness to be contacted were included in the survey distribution. Finally, identified Six Sigma organizations were queried for potential respondent contacts either through information queries on their websites or by direct telephone calls.

The resulting population used in the survey distribution included 606 individual Email contacts, with 206 iSixSigma identified organizations, 15 NIST/MEP organizations, and 385 ASQ members. The sample studied included respondents to the Six Sigma survey. As the population and sample were not entirely random, the ability to generalize results was limited.

Variables

Program maturity for Research Question 1 included Hypotheses 1-3. For Hypothesis 1, the dependent variable was program maturity (ratio) and independent variables were organization size (large versus SME, coded interval) and business classification (manufacturing versus non-manufacturing, coded nominal). In Hypothesis 2, the dependent variable was program maturity factors (leadership, customer focus, strategy, project management, evaluation/motivation, infrastructure, business results) which were ratio. Hypothesis 2 independent variables were organization size (large versus SME, coded interval) and business classification (manufacturing versus non-manufacturing, coded nominal). The dependent variable for Hypothesis 3 was program maturity (ratio) and independent variable was years of implementation (interval), answered by respondents directly in the survey as (1) less than 1 year, (2) 1-2 years, (3) 3-5 years, (4) 6-9 years, (5) 10-14 years, (6) 15-19 years, and (7) 20+ years.

Financial Performance for Research Question 1 and Research Question 2 included Hypotheses 4-5. The dependent variable for Hypothesis 4 was financial performance (gross profit margin and operating margin, ratio) and the independent variables were organization size (large versus SME, coded interval) and business classification (manufacturing versus non-manufacturing, coded nominal). Gross profit margin and operating margin financial variables were chosen to normalize the data for organizational size (W. Kryshak, personal communication, September, 2009). The financial data requested was annual data for the most recent year of readily available financial data, the year 2008. Hypothesis 5 utilized financial performance (gross profit margin and operating margin, ratio) as the dependent variable and program maturity level (coded interval/ranked) as the independent variable.

Six Sigma maturity level was calculated based on rating responses received in the survey. Ratings were totaled for each of seven areas in the assessment and a total rating was tabulated as in Table 4. Details for the calculations are listed in Appendix B.

Table 4

Program Maturity Rating Levels.

	Range of Rating Results by Level				
Maturity Area	Level 1	Level 2	Level 3	Level 4	Level 5
1. Six Sigma Leadership	0-2	3-4	5-6	7-8	9-10
2. Customer Focus	0-2	3-4	5-6	7-8	9-10
3. Six Sigma Strategy	0-4	5-8	9-12	13-16	17-20
4. Six Sigma Project Mgt	0-4	5-8	9-12	13-16	17-20
5. Evaluation/Motivation	0-4	5-8	9-12	13-16	17-20
6. Six Sigma Infrastructure	0-11	12-22	23-33	34-44	45-55
7. Business Results	0-8	9-16	17-24	25-32	33-40
Totals	0-35	36-70	71-105	106-140	141-175

Data for statistical analysis for independent variables were coded as in Table 5.

Table 5

Independent Variable Definitions and Coding.

	Program Maturity	Organization Size		Business Classification	
	Level	SME	Large	Mfg	Non-Mfg
Code	1-5	1	2	1	2

Research Instrumentation

Instruments and tools used in testing included a survey tool in electronic format, Email, and the internet. The survey instrument is listed in Appendix A.

Survey Development Procedures and Data Collection

A survey of 10 questions, with 44 Likert-type rating questions for each category in question 10 was developed based on previous research surveys and desired objectives for the study. After initial approval by the study committee, the survey was inserted into an electronic survey tool, Qualtrics, at the University of Wisconsin-Stout where revisions to questions were made based on general survey protocols and standard survey question formatting. An initial screening question was added at the beginning of the survey to verify the respondent worked in an organization that utilized Six Sigma. If the respondent did not work in a Six Sigma organization, they exited the survey. If a respondent did work in a Six Sigma organization, they progressed to complete the survey.

The survey was tested and revised based on reviewer feedback to improve and validate the survey questions. Eleven individuals reviewed and tested the electronic instrument to ensure questions were stated appropriately and the internet interface and data collection worked properly to produce data that would be transferable and usable. Qualified individuals had expertise in survey development, statistical survey analysis, or Six Sigma from SMEs and large organizations, as well as manufacturing and non-manufacturing organizations. Individuals included:

1. Justin Gilbert, Master Black Belt (MBB), Transformation and Strategy Program Manager, IBM ISC Global Engineering.
2. Rich Berg, Senior Staff Project Engineer, Lockheed Martin.

3. Brad McEnroe, Project Engineer, Embedded Black Belt Senior, Lockheed Martin.
4. Steve Casey, Six Sigma Black Belt (SSBB), Lockheed Martin.
5. Steve Yahr, SSBB, Lockheed Martin.
6. Ted Mattis, SSBB, Quality Manager, Woodward Turbine Combustion Systems.
7. Karl Palmer, R.N., Six Sigma Project Manager, Mayo Clinic /Red Cedar Medical Center.
8. JoEll Hashemi, SSBB, Product Line Manager, Honeywell.
9. Maureen Cochran, Qualtrics Support, Applied Research Center, University of Wisconsin-Stout.
10. Aaron Bialzik, SSBB, Outreach Project Engineer, Stout Technology Transfer Institute, University of Wisconsin-Stout.
11. Renee Surdick, Ed.D., Research Program Manager, Stout Technology Transfer Institute, University of Wisconsin-Stout.

Institutional Research Board (IRB) human subject testing approval was obtained from Indiana State University (IRB #10-100) and the University of Wisconsin-Stout in compliance with the Code of Federal regulations Title 45 Part 46.

An Email distribution list of 606 potential respondents was assembled. Organizations utilizing Six Sigma were identified based on lists provided on the ASQ, iSixSigma, and NIST/MEP websites. Contact information was gathered from public information available on the ASQ and NIST/MEP member websites, as well as Hoover's company contact information (Hoover's, 2010). Direct requests for contact Emails were submitted to company information request websites for organizations where contact information was not available. Specific ASQ sites providing contact information included the Six Sigma Forum, member searches for Six

Sigma interested individuals, section leadership, and membership lists where members approved sharing of contact information. The survey was opened for a three-week time period. After completion of the survey, data was exported from the survey tool to Microsoft Excel, SPSS (Statistical Package for the Social Sciences) 16.0, and Minitab 15 for archiving and analysis purposes. The survey for this study is listed in Appendix A.

The summarized steps of the research procedure included,

Step 1. Constructed a draft of the electronic survey in Qualtrics. The draft was based on the initial approval by the dissertation committee from the dissertation defense.

Step 2. Submitted the request for research approval to the Indiana State University Institutional Review Board (IRB).

Step 3. Contacted experts to serve as a panel to pilot test the electronic survey. Experts included Six Sigma certified, survey, and research professionals, managers, and engineers.

Step 4. Conducted a pilot survey with the panel of experts.

Step 5. Created an initial list of Six Sigma organizations from iSixSigma and ASQ public online information. Researched and contacted ASQ, iSixSigma, and NIST/MEP organization members to build the Email distribution list. Utilized Hoover's public online information and accessed identified Six Sigma organization websites to obtain Email addresses not found at the contacted organizations.

Step 6. Finalized the survey incorporating minor revisions based on feedback from six of the eleven panel experts.

Step 7. Emailed the survey with an imbedded electronic link to the distribution list of 606 potential respondents. Followed up with three reminder Emails every six days. Also, attempted to call potential respondents with publicly provided telephone numbers for approximately 10 hours after the first week to ask for their participation in the study.

Step 8. Gathered data from the survey in the Qualtrics electronic survey tool. Data was exported to Microsoft Excel to code levels for program maturity.

Step 9. Interpreted the results for the study. SPSS, Minitab, and Qualtrics were used for the statistical analysis.

Statistical Analysis and Assumptions

Microsoft Excel, SPSS 16.0, Minitab 15, and Qualtrics were used as the statistical analysis tools. Raw data recorded in the survey tool was exported to the Microsoft Excel, SPSS, and Minitab applications for analysis.

Normality

Kolmogorov-Smirnov tests were completed to test normality with significance level results. The null hypothesis for significance of normality is, if $p > .05$, do not reject (Kales, 1998). The test was utilized for the survey program maturity and financial data. Histograms were also used to test for normality and are presented in Appendix C.

Descriptive Statistics

Descriptive statistics were used to describe respondent demographic and organization data. The techniques were also used to detail other results as appropriate.

Regression

Multiple linear regression was utilized to test the relationships in Hypotheses 1-5. Regression analysis helps to understand how independent variables are related to a dependent variable (Norusis, 2005). The null hypothesis is tested by using the F test and related significance value. If the overall test is not significant, there is no linear relationship between the dependent variable and all of the independent variables, so the null hypothesis cannot be rejected. Assumptions of regression include independent or predictor variables must be independent of each other, distribution of values for the dependent variable must be normal, variance of the dependent variable distribution must be equal, and the relationship between dependent and independent variables must be linear. Regression also assumes that the dependent variable is ratio or coded nominal/rank and independent variables are either interval or ratio.

The standard multiple linear regression equation is,

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ \dots + \beta_n X_{n2}$$

where $\hat{Y}$ is the dependent value and X_i is the *i*th independent variable. Regression equations were used for the hypotheses in the study. For Program Maturity Hypothesis 1 and Hypothesis 3 used the following regression equation

$$ProgMat = \ \beta OrgSize_{(1,2)} + \beta BusClass_{(1,2)} + \beta YearsofImpl_{1,2,3,4,5,6,7} + \beta 0$$

where ProgMat was the dependent variable program maturity (ratio), OrgSize was the independent variable organization size (large/SME, coded interval), BusClass was the independent variable business class (manufacturing/non-manufacturing, coded nominal), and YearsofImpl was the independent variable years of implementation (interval).

The regression equation used for Program Maturity Factors in Hypothesis 2 was

$$ProgMatFactors_{(1,2,3,4,5,6,7)} = \ \beta OrgSize_{(1,2)} + \beta BusClass_{(1,2)} + \beta 0$$

where ProgMatFactors was the dependent variable program maturity factors (ratio), OrgSize was the independent variable organization size (large/SME, coded interval), and BusClass was the independent variable business class (manufacturing/non-manufacturing, coded nominal). Program maturity factors included leadership, customer focus, strategy, project management, evaluation/motivation, infrastructure, and business results).

Financial Performance for Hypothesis 4 and Hypothesis 5 used the following regression equation:

$$FinPerf_{(1,2)} = \beta OrgSize_{(1,2)} + \beta BusClass_{(1,2)} + \beta ProgMatLev_{(1,2,3,4,5)} + \beta 0$$

where FinPerf was the dependent variable financial performance (gross profit margin, operating margin, ratio). OrgSize was the independent variable organization size (large/SME, coded interval), BusClass was the independent variable business class (manufacturing/non-manufacturing, coded nominal), and ProgMatLev was the independent variable program maturity level (level 1-5, coded interval).

Statistics for regression include R, R square (R^2), and Adjusted R square (Adj R^2). R is the correlation coefficient between observed and predicted values and ranges from 0 to 1 (Norusis, 2005). R^2 is the proportion of dependent variable variability attributed to the regression equation and indicates the percentage of observed variability attributed to differences in the independent variables. Adjusted R^2 corrects R^2 to prevent an overly optimistic estimate of how well the model fits and population by decreasing the value appropriately.

Bivariate, part, and partial correlations were also conducted as part of the regression tests. Part and partial correlation coefficient values can range from -1 to +1 (Norusis, 2005). Large absolute values for the part coefficient values indicate that the variable provides unique information about the dependent variable not available from other independent variables in the regression equation. The partial correlation coefficient is the coefficient between the independent and the dependent variable when the linear effects of other independent variables have been removed from dependent and independent variables. The square of the partial correlation coefficients indicates what proportion of the unexplained variance in the dependent variable is explained by that variable. Related t-values and p-values can be used to evaluate the significance of the B weights, beta weights, part correlations, and partial correlations (Green & Salkind, 2008). The bivariate correlations are labeled Zero-order in the SPSS output, while part correlations are labeled Part, and partial correlations are labeled Partial.

In addition to normality, assumptions of regression are linearity, homogeneity or equality of variance, and independence (Minium, Clarke & Coladarci, 1999). To test linearity and equality of variance, scatter plots and plots of the residuals can be created for the predicted values of the dependent variable against each of the independent variables (Norusis, 2005). If there is a visible pattern in the scatter plots, the relationship between the dependent variable and the independent variables may not be linear. Also, if the spread of residuals changes over the independent variable range, the assumption of equal variances may be violated. If observations of residuals form a pattern where small or large residuals are located next to each other, the observations may not be independent. P-P plots and scatter plots were created for program maturity and financial performance data and are available in Appendix E.

Levene's test for equality of variances was also used to test the homogeneity of variance. If the p-value resulting from Levene's test is less than some critical value such as .05, it is unlikely that the differences in sample variances have occurred based on random sampling (Norusis, 2005). As a result, the null hypothesis of equal variances is rejected and it can be concluded that there is a difference between variances.

Durbin-Watson tests were utilized to test for independence and correlation of adjacent residuals, with potential values ranging from 0 to 4 (Norusis, 2005). If residuals are not correlated, values are close to 2. Values less than 2 indicate adjacent residuals are positively correlated and values greater than 2 indicate a negative correlation.

Reliability

It is important to assess how reliably a survey measures results as intended (Norusis, 2005). Good tests produce values that correlate well with an unknown true score. Cronbach's alpha, a measure of internal consistency, was used to assess how reliably survey questions designed to measure the program maturity construct actually did so. Cronbach's alpha values range from 0 to 1. Higher values suggest higher internal consistency, indicating questions are correlated and measure the same construct. Good scales have values larger than 0.8.

Summary

Chapter 3, Methodology, provided the statement of the problem, preliminary findings based on authorities, research questions, and hypotheses for this study. Additionally, the chapter discussed the Type I error selection, population and sampling, variables to be utilized, research instrumentation, as well as survey development procedures and data collection. Finally, Chapter 3 discussed the statistical analysis to be used and related assumptions.

CHAPTER 4

RESULTS

This chapter presents results from the data analysis of the Six Sigma Survey which collected data from large and small-to-medium organizations in the United States utilizing Six Sigma systems in manufacturing and non-manufacturing. The purpose of the study was to examine the financial performance of Six Sigma companies and analyze the relevance of the financial performance comparing organization size, business classification, and program maturity. Financial performance was based on 2008 operating margin and gross profit margin. In addition, the study examined factors related to Six Sigma program maturity.

The electronic survey was distributed using Email to a distribution list of 606 individuals. The Email provided the survey purpose, contact information, IRB information, and a URL link to the survey or to unsubscribe from future reminders. There were 118 responses and a total response rate of 19%. Of the 118 responses, 87 (74% of 118) came from individuals working in organizations utilizing Six Sigma, resulting in a usable total response rate of 14% from the distribution list. The number of responses to specific questions varied as detailed in the findings.

The findings are organized in three parts. Part 1 provides a descriptive statistical overview of demographic and organization survey question results. Part 2 presents the results and statistical analysis for program maturity in Hypotheses 1-3 and Part 3 presents results and statistical analysis for financial performance in Hypotheses 4-5. Research questions and related hypotheses include:

Research Question 1: What are the relationships inherent in organization size, business classification, and organizational financial performance as related to Six Sigma system maturity?

Research Question 2: What is the relationship of Six Sigma program success relative to organizational financial performance, organization size, business classification, and program maturity of the Six Sigma system?

Research questions were further developed into the hypotheses. Hypotheses 1-3 relate to program maturity for research question one and Hypotheses 4-5 relate to financial performance for research question one and research question two.

Hypothesis 1: Program Maturity for Organization Size and Business Classification

H_{01}: $\beta j = 0$. There is no statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 2: Program Maturity Factors for Organization Size and Business Classification

H_{02}: $\beta j = 0$. There is no statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 3: Program Maturity for Years of Implementation

H_{03}: $\beta j = 0$. There is no statistically significant relationship between program maturity and years of implementation.

H_{a3}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and years of implementation.

Hypothesis 4: Financial Performance for Organization Size and Business Classification

H_{04}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a4}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 5: Financial Performance for Program Maturity Level

H_{05}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

H_{a5}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

Part 1 – Demographic and Organization Data

This part provides a descriptive statistical overview of demographic and organization survey question results. There were four survey questions, one through four, regarding organization and respondent demographics, and two questions, six and seven, regarding Six Sigma organization background. Questions are presented with descriptive statistical results.

Survey Question 1 – Number of employees in your organization and Survey Question 2 – Your organization's primary business classification:

Table 6

Organization Size and Primary Business Classification.

Organization Size	Business Classification		
	Manufacturing	Non-manufacturing	Total
SME (<=2500)	36	6	42
Large (>2500)	36	9	45
Total	72	15	87

Usable data from Survey Question 2.1 – Please specify non-manufacturing classification:

Table 7

Non-manufacturing Classification.

Classification	Frequency	Percent
Retail Trade	1	7%
Finance, Insurance, Real Estate	1	7%
Services	5	33%
Other	8	53%

15 Survey respondents participated in this question.

Other classifications included one software, five health care, one advertising, and one education organization.

Usable data from Survey Question 3 – Your department or function:

Table 8

Department or Function.

Department/Function	Frequency	Percent
Executive	4	5%
Research and Development	5	6%
Quality	62	71%
Finance, Accounting	2	2%
Supply Chain Management, Purchasing	4	5%
Customer Service	2	2%
Other	8	9%

87 Survey respondents participated in this question.

Other departments and functions included two continuous improvements and one each of Six Sigma, manufacturing engineering, sales, training, and multi-channel call center.

Survey Question 4 – Your position:

Table 9

Respondent Position.

Position	Frequency	Percent
Management	34	39%
Six Sigma Master Black Belt	9	10%
Six Sigma Black Belt	9	10%
Six Sigma Green Belt	11	13%
Other	24	28%

87 Survey respondents participated in this question.

Other positions were related to engineering, quality, management, and consulting. Engineer and quality positions included two engineers and one each of Lean Six Sigma sensei, quality systems manager, quality analyst, project quality engineer, manufacturing engineer, QA engineer, quality engineer, lead auditor, senior supplier quality engineer, ISO management representative, senior quality engineer and Master BB, product surveillance, manager continuous improvement, worker bee, technical consultant (SSGB), and CQT. Management and consulting positions included corporate deployment champion, program manager, consultant, and regulatory specialist.

Survey Question 5 – Number of years Six Sigma methods and systems have been utilized in your organization:

Table 10

Number of Years Six Sigma Utilized.

	Number of Years	Frequency	Percent
1	Less than 1	5	6%
2	1 – 2	9	11%
3	3 – 5	36	43%
4	6 – 9	20	24%
5	10 – 14	8	10%
6	15 – 19	3	3%
7	20+	3	3%

84 Survey respondents participated in this question.

Survey Question 6 – Number of projects per year that utilize Six Sigma methods:

Table 11

Number of Projects per Year Utilizing Six Sigma.

Number of Projects	Frequency	Percent
1 – 5	35	42%
6 – 9	18	21%
10 – 19	4	5%
20+	27	32%

84 Survey respondents participated in this question.

Survey Question 7 – Positions and Six Sigma certified employees that directly support Six Sigma efforts (check all that apply):

Table 12

Positions Supporting Six Sigma Efforts.

Position	Frequency	Percent
Champions	52	65%
Executive Sponsors	42	53%
Yellow Belts	21	26%
Green Belts	62	78%
Black Belts	65	81%
Master Black Belts	43	54%

80 Survey respondents participated in this question.

Part 2 – Hypotheses 1-3: Relationships for Six Sigma Program Maturity

Six Sigma program maturity was addressed in Hypotheses 1-3 by a set of seven categories and questions for each category included in Survey Question 10. Categories included Six Sigma leadership, customer focus, Six Sigma strategy, Six Sigma project management, Evaluation/Motivation, Six Sigma infrastructure, and business results. Responses to Question 10 were based on respondent perceptions using a Likert-type rating of one through five. A rating of five was strongly agree, four was agree, three was disagree, two was strongly disagree, and one was uncertain. Question 10 results are included in Table 13 through Table 19, followed by the statistical analyses.

The first category for Program Maturity was Six Sigma leadership and included two questions, Q10.1.1 Organization vision and core values include Six Sigma continuing efforts and Q10.1.2 Executive leadership visibly participates in Six Sigma efforts. Percentage results are listed in Table 13.

Table 13

Program Maturity – Six Sigma Leadership.

Question	Strongly Agree	Agree	Disagree	Strongly Disagree	Uncertain
10.1.1 Vision/Core Values	23%	59%	14%	0%	4%
10.1.2 Executive Participation	21%	40%	23%	6%	10%

69 Survey respondents participated in this question.

The second category for Program Maturity, customer focus, included two questions, Q10.2.1 Projects utilizing Six Sigma methods and systems are selected based on the Voice-of-the-Customer (VOC) and Q10.2.2 Projects utilizing Six Sigma methods and systems use customer satisfaction metrics and measurements to provide feedback and evaluate continuous improvement efforts. Percentage results are listed in Table 14.

Table 14

Program Maturity – Customer Focus.

Question	Strongly Agree	Agree	Disagree	Strongly Disagree	Uncertain
VOC	21%	52%	18%	3%	6%
Feedback Metrics	19%	55%	16%	3%	7%

69 Survey respondents participated in this question.

The third category for Program Maturity, Six Sigma strategy, included four questions, Q10.3.1 A Six Sigma strategy development process is well-defined, documented, and followed, Q10.3.2 Six Sigma efforts align with organizational strategies, Q10.3.3 A process to make decisions regarding when to utilize Six Sigma methods and systems is well-defined, documented, and followed, and Q10.3.4 Key performance metrics that include Six Sigma efforts are well-defined, documented, and followed. Percentage results are listed in Table 15.

Table 15

Program Maturity – Six Sigma Strategy.

Question		Strongly Agree	Agree	Disagree	Strongly Disagree	Uncertain
10.3.1	Strategy Process	13%	49%	28%	7%	3%
10.3.2	Strategic Alignment	25%	59%	7%	3%	6%
10.3.3	Decision Process for Use of Six Sigma	12%	38%	40%	4%	6%
10.3.4	Key Performance Metrics	10%	49%	32%	6%	3%

68 Survey respondents participated in this question.

The fourth category for Program Maturity, Six Sigma project management, included four questions, Q10.4.1 A decision process to identify and select projects to utilize Six Sigma methods and systems is well-defined, documented, and utilized, Q10.4.2 Project management procedures and tools for projects utilizing Six Sigma methods and systems are well-defined, documented, and utilized, Q10.4.3 Project tracking and oversight for projects utilizing Six Sigma methods and systems is well-defined, documented, and utilized, and Q10.4.4 Project evaluation metrics for projects utilizing Six Sigma methods and tools are well-defined, documented, and utilized. Percentage results are listed in Table 16.

Table 16

Program Maturity – Six Sigma Project Management.

Question		Strongly Agree	Agree	Disagree	Strongly Disagree	Uncertain
10.4.1	Decision Process for Project Selection	12%	47%	31%	4%	6%
10.4.2	Project Mgt. Procedures and Tools	13%	57%	24%	3%	3%
10.4.3	Tracking and Oversight	15%	53%	26%	3%	3%
10.4.4	Project Evaluation Metrics	13%	55%	24%	3%	5%

68 Survey respondents participated in Q10.4.1, Q10.4.2, and Q10.4.3.

67 Survey respondents participated in Q10.4.1.

The fifth category for Program Maturity, Evaluation/Motivation, included four questions, Q10.5.1 Team performance assessment processes are well-defined, documented, and followed, Q10.5.2 Performance metrics for employees responsible for deploying and maintaining Six Sigma methods and systems is well-defined, documented, and followed, Q10.5.3 A reward and recognition process for employees working on Six Sigma efforts is well-defined, documented, and followed, and Q10.5.4 Career development paths for employees responsible for Six Sigma efforts are well-defined, documented, and followed. Percentage results are listed in Table 17.

Table 17

Program Maturity – Evaluation/Motivation.

	Question	Strongly Agree	Agree	Disagree	Strongly Disagree	Uncertain
10.5.1	Team Performance Assessment	12%	38%	38%	5%	7%
10.5.2	Employee Performance Metrics	12%	43%	32%	6%	7%
10.5.3	Reward and Recognition	7%	24%	51%	12%	6%
10.5.4	Career Development Paths	6%	23%	50%	15%	6%

68 Survey respondents participated in this question.

The sixth category for Program Maturity, Six Sigma Infrastructure, included eleven questions, Q10.6.1 Six Sigma methods, systems, and procedures are well-defined, documented, and followed, Q10.6.2 The Six Sigma training system is effective, Q10.6.3 The Six Sigma body of knowledge is well-known throughout the organization, Q10.6.4 Communication related to Six Sigma strategies, plans, projects, and outcomes is effective, Q10.6.5 All employees in the organization are involved in Six Sigma strategies, plans, and related projects, and Q10.6.6 The quality and availability of Six Sigma results data is effective for improvement purposes. Additionally, Q10.6.7 The information technology system related to Six Sigma data is effective, Q10.6.8 Support for the information technology system related to Six Sigma data is effective, Q10.6.9 Knowledge management and sharing of Six Sigma data is effective, Q10.6.10 Six Sigma methods and systems are deployed effectively throughout the organization's supply chain, and 10.6.11 Six Sigma methods and systems are deployed effectively with strategic partners and alliances. Percentage results are listed in Table 18.

Table 18

Program Maturity – Six Sigma Infrastructure.

Question	Strongly Agree	Agree	Disagree	Strongly Disagree	Uncertain
10.6.1 Methods, Systems, Tools, Procedures	18%	50%	26%	3%	3%
10.6.2 Training System	15%	50%	19%	6%	10%
10.6.3 Body of Knowledge	10%	26%	43%	9%	12%
10.6.4 Communication	10%	37%	31%	12%	10%
10.6.5 Employee Involvement	6%	10%	45%	34%	5%
10.6.6 Results Data Quality and Availability	9%	55%	19%	10%	7%
10.6.7 IT System Effectiveness	6%	40%	32%	15%	7%
10.6.8 IT System Support	8%	35%	35%	16%	6%
10.6.9 Knowledge Mgt.	7%	34%	44%	5%	10%
10.6.10 Supply Chain	4%	13%	52%	21%	10%
10.6.11 Strategic Partners and Alliances	6%	21%	42%	21%	10%

68 Survey respondents participated in Q10.6.1 – Q.10.6.4 and Q10.6.6 – Q10.6.10.

67 Survey respondents participated in Q10.6.5 and Q10.6.11.

The seventh category for Program Maturity, Business Results, included eight questions, Q10.7.1 Internal customers are satisfied with the results of projects utilizing Six Sigma methods and systems, Q10.7.2 External customers are satisfied with the results of projects utilizing Six Sigma methods and systems, Q10.7.3 Financial results and returns on investment for projects utilizing Six Sigma methods and systems are positive, Q10.7.4 Six Sigma efforts cultivate talent development of employees, Q10.7.5 Six Sigma efforts positively impact employee satisfaction, Q10.7.6 Six Sigma efforts positively contribute to internal business process improvements, Q10.7.7 Six Sigma efforts improve supply chain results, and Q10.7.8 Six Sigma efforts improve the corporate culture. Percentage results are listed in Table 19.

Table 19

Program Maturity – Six Sigma Business Results.

	Question	Strongly Agree	Agree	Disagree	Strongly Disagree	Uncertain
10.7.1	Internal Customer Satisfaction	9%	59%	19%	3%	10%
10.7.2	External Customer Satisfaction	6%	44%	19%	4%	27%
10.7.3	Financial Results	13%	63%	11%	3%	10%
10.7.4	Talent Development	15%	52%	22%	4%	7%
10.7.5	Employee Satisfaction	7%	49%	22%	6%	16%
10.7.6	Internal Process Improvement	19%	62%	7%	3%	9%
10.7.7	Supply Chain Results	4%	41%	25%	6%	24%
10.7.8	Corporate Culture	13%	43%	25%	4%	15%

68 Survey respondents participated in Q10.7.1 – Q.10.7.2 and Q10.7.4 – Q10.7.8.

67 Survey respondents participated in Q10.7.3.

Program Maturity Analysis

Results showed that 72% of respondents rated their organization's program maturity at level 4, followed by 11% at level 3, 10% at level 5, and 3% at level 2 and level 1. Regression was performed to evaluate the relationship between program maturity and organization size, business classification, and years of implementation. The independent variables were organization size (large versus small-to-medium), business classification (manufacturing versus non-manufacturing), and years of implementation (1-7). The dependent variable was program maturity. The results were not significant and the apparent unstandardized coefficients, Bs, are the weights for the regression equation as follows:

Program Maturity = -2.24 OrgSize + 2.66 BusClass + 3.28 YearsofImpl + 108.8

The linear combination of organization size, business classification, and years of implementation were not significantly related to program maturity, $R = .18$, $R^2 = .03$, Adj $R^2 = -.01$, $F(3,64) = .729$, $p = -.54$. Apparent results indicate the sample multiple correlation coefficient was .18 and R^2 indicated that approximately 3% of the variance of the program maturity index in the sample could be accounted for by the linear combination of organization size, business classification, and years of implementation. The t values and related p values were not significant for the B weights. Apparent results of the bivariate and partial correlations of the independent variables with the program maturity dependent variable are listed in Table 20. Detailed results of the regression tests can be found in Appendix E.

Table 20

Bivariate and Partial Correlations for Program Maturity.

Independent Variables	Bivariate	Partial
Organization Size	-.04	-.05
Business Classification	.04	.05
Years of Implementation	.17	.17

The K-S normality test for program maturity data was significant, $p < .01$. However, the data plot and the scatter plots indicated that data follow a positive linear slope. The sample size of 68 showed a relatively normal distribution and the Normal P-P plot of standardized residuals indicates some deviation from the slope line. The minimum standardized value for the residual was -3.49 and the maximum standardized residual value was 2.29, indicating data values approximately -3.5 to 2.3 standard deviations away from the mean of zero. K-S graphs are displayed in Appendix C and the other statistics and graphs are detailed in Appendix E. Levene's test for equal variance was not significant, $p = .75$, as detailed in Appendix D. The Durbin-Watson test for independence of variables was 2.07, indicating residuals were not correlated.

Program Maturity Factor Analysis

The program maturity factors were calculated based on survey response totals for each factor, which were translated to the appropriate level (1-5) as listed in Table 4 Program Maturity Rating Levels. Factors included leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, and business results. Descriptive statistics show the mean levels ranged from 3.57 for Evaluation/Motivation to 4.01 for strategy as listed in Table 21.

Table 21

Mean and Standard Deviation of Program Maturity Factor Levels.

Factors	Mean	Std. Dev.
Leadership	3.93	.89
Customer Focus	3.88	1.02
Strategy	4.01	.80
Project Mgt.	3.82	.88
Evaluation/Motivation	3.57	.87
Infrastructure	3.62	.86
Business Results	3.74	.90

Regression was used to evaluate the relationship between program maturity factors and organization size, as well as the relationship between program maturity factors and business classification. Organization size resulted in two equal groups with 34 SMEs and 34 large organizations. Business classification groups included 55 manufacturing and 13 non-manufacturing organizations. The independent variable groups were organization size (large versus small-to-medium) and business classification (manufacturing versus non-manufacturing). The dependent variables were program maturity factors. Results were not significant and the apparent results of the regression equations are presented in Table 22.

Table 22

Unstandardized Regression Coefficients for Program Maturity Factors.

Factor	Organization Size	Business Class	Constant
Leadership	.03	.03	7.44
Customer Focus	-.52	.55	7.69
Strategy	-.59	.16	15.29
Project Mgt.	.18	.01	14.40
Evaluation/Motivation	.06	-.05	13.09
Infrastructure	1.11	.29	33.26
Business Results	-.20	1.49	28.35

The t values and related p values were not significant for the B weights. The regression tests for the relationship between program maturity factors with organization size and business classification were not significant and analysis results are presented in Table 23. Detailed results of the regression tests can be found in Appendix E.

Table 23

Regression Results for Program Maturity Factor Relationships.

Program Maturity Factors	R	R^2	Adj R^2	F	Sig
Leadership	.01	.00	-.03	.003	.997
Customer Focus	.17	.03	.00	1.00	.37
Strategy	.09	.01	-.02	.28	.76
Project Mgt.	.03	.001	-.03	.02	.98
Evaluation/Motivation	.01	.00	-.03	.01	.995
Infrastructure	.07	.004	-.03	.15	.86
Business Results	.17	.03	.00	1.00	.37

Cronbach's alpha test for reliability was conducted on the seven program maturity factors. Cronbach's test produced a value of 0.898, indicating evidence existed that the seven factors measured the same construct, program maturity. Also, Cronbach's alpha for individual factors ranged from .87 to .89.

The K-S normality test for program maturity factors data indicated that leadership, strategy, and evaluation/motivation were not significant. However, customer focus, project management, infrastructure, and business results were significant. While the K-S plots tended to collect near the slope line, there was deviation from normality particularly at the end points. Scatter plots indicated data followed a positive linear slope. Levene's test was not significant for any factors, indicating the equality of variances assumption was not violated.

Durbin-Watson independence tests for correlation of adjacent residuals ranged from 1.56 to 2.38. Program maturity factor Durbin-Watson values were Leadership (1.56), Customer (2.14), Strategy (1.73), Project Management (1.94), Evaluation/Motivation (2.01), Infrastructure (1.98), and Business Results (2.38). A value of 2 indicates that residuals are not correlated. Leadership, Strategy, and Project Management were less than 2 indicating a slight positive correlation. Business Results was greater than 2 indicating a slight negative correlation.

Part 3 – Hypotheses 4-5: Relationships for Six Sigma Financial Performance

This part asked two questions regarding financial measurements for the Year 2008. Q8 Please enter your organization's Gross Profit Margin for the year 2008 resulted in 77 responses. There were 16 (21%) numerical responses and 14 (18%) responses were usable. Additionally, there were six (8%) responses of Not Applicable for the Organization and 55 (71%) responses for Don't Know. Gross profit margin values were provided by six SMEs, eight large organizations, eleven manufacturing, and three non-manufacturing organizations. Descriptive statistics for values provided include minimum(1.5), maximum(70.0), mean(29.44), SD(17.96), and variance(322.47).

Q9 Please enter your organization's Operating Margin for the year 2008 resulted in 77 responses. Of the 13 (17%) numerical responses, 12 (16%) were usable. Also, there were six (8%) Not Applicable for the Organization and 58 (75%) Don't Know. Operating margin values were provided by three SMEs, nine large organizations, eight manufacturing, and four non-manufacturing organizations. Descriptive statistics for values provided include minimum(-2.9), maximum(17.0), mean(8.21), SD(6.68), and variance(44.58).

Regression was performed to evaluate the relationship between financial performance and organization size, business classification, and program maturity level. The independent grouping variables were organization size (large versus small-to-medium), business classification (manufacturing versus non-manufacturing), and program maturity level (levels 1-5). The dependent variable was financial performance (gross profit market and operating margin). Results were not significant and the apparent unstandardized coefficients, Bs, of the weights for the resulting regression equations are as follows:

$$\text{FinPerf(GrossProfMarg)} = -10.06\ \text{OrgSize} + 7.24\ \text{BusClass} - 8.25\ \text{ProgMatLev} + 67.69$$

$$\text{FinPerf(OpMarg)} = -6.88\ \text{OrgSize} - 1.85\ \text{BusClass} - .23\ \text{ProgMatLev} + 23.53$$

The linear combination of organization size, business classification, and program maturity level were not significantly related to financial performance (gross profit margin), $R = .49$, $R^2 = .24$, Adj $R^2 = .01$, $F(3,10) = 1.06$, $p = .41$ or financial performance (operating margin), $R = .54$, $R^2 = .29$, Adj $R^2 = .02$, $F(3,8) = 1.07$, $p = .41$. The apparent gross profit margin sample multiple correlation coefficient was .49 indicating that approximately 24% of the variance of the gross profit margin index in the sample could be accounted for by the linear combination of organization size, business classification, and program maturity level. The apparent operating margin sample multiple correlation coefficient was .54 indicating that approximately 29% of the variance of the gross profit margin index in the sample could be accounted for by the linear combination of organization size, business classification, and program maturity level. The t values and related p values were not significant for the B weights. The apparent bivariate and partial correlations of the independent variables with the program maturity dependent variable are listed in Table 24. Results of the regression tests are detailed in Appendix E.

Table 24

Bivariate and Partial Correlations for Financial Performance.

Independent	Gross Profit Margin		Operating Margin	
Variable	Bivariate	Partial	Bivariate	Partial
Organization Size	-.25	-.31	-.52	-.45
Business Class	.09	.19	-.33	-.15
Program Maturity Level	-.37	-.42	-.01	-.04

Kolmogorov-Smirnoff (K-S) tests were performed to test for normality of the survey financial data. The null hypothesis for normality is, if $p > .05$, do not reject. The survey data was normal for both gross profit margin and operating margin ($p > .15$). The histograms and Normal P-P plots of standardized residuals indicate some deviation from normality. The minimum standardized residual value for gross profit margin was -1.14 and the maximum value was 2.14. Also, the minimum standardized residual value for operating margin was -1.22 and the maximum was 1.79, indicating values with approximately -1 or 2 standard deviations away from the mean of zero. Scatter plots indicated that data followed a positive linear slope. K-S graphs are displayed in Appendix C and the other statistics and graphs are detailed in Appendix E. Additionally, Levene's tests for equal variance were not significant for gross profit margin ($p = .31$) and operating margin ($p = .74$), as detailed in Appendix D. The Durbin-Watson test for independence of variables was 2.81for gross profit margin and 2.72 for operating margin, indicating residuals had a slight negative correlation.

Summary

This chapter presented results from the data analysis of the Six Sigma survey. Financial performance was based on 2008 operating margin and gross profit margin. Analysis results for Six Sigma program maturity were also presented. The information was presented in three parts. Part 1 provided a descriptive statistical overview of demographic and organization survey question results. Part 2 presented results based for Hypotheses 1-3 and Part 3 presented results based for Hypotheses 4-5.

Survey results were gathered from 87 respondents representing organizations that have implemented Six Sigma. Respondents were grouped by organization size (SME versus large) and business classification (manufacturing versus non-manufacturing). SMEs responded with 48% and large organizations with 52%. Manufacturing responded with 83% and non-manufacturing responded with 17%. In the manufacturing group, 50% were SMEs and 50% were large organizations. The non-manufacturing group consisted of 40% SMEs and 60% large organizations. In the large group, 80% were manufacturing and 20% were non-manufacturing. SMEs responded with 86% from manufacturing and 14% from non-manufacturing. The largest group of respondents worked in the quality function (71%) and held positions either in management (40%) or as certified Six Sigma professionals (33%). The majority of respondents indicated their organizations had utilized Six Sigma 3-5 years (43%), followed by 6-9 years (24%). The number of Six Sigma projects per year varied with 1-5 (42%), 6-9 (21%), and more than 20 (32%). Additionally, the majority of respondents (72%) ranked their organizations at program maturity level 4 out of 5, with 5 being best.

Hypotheses 1-3 were tested to determine the relationships in organization size, business classification, and financial performance as related to Six Sigma program maturity.

The first null hypothesis was not rejected; there was no significant relationship between program maturity and SMEs and large organizations or manufacturing and non-manufacturing organizations.

The second null hypothesis was not rejected; there was no significant relationship between program maturity factors and SMEs and large organizations or manufacturing and non-manufacturing organizations.

The third null hypothesis was not rejected; there was no significant relationship between program maturity and years of implementation.

Hypotheses four and five were tested to determine relationships in Six Sigma program success relative to financial performance, organization size, business classification, and Six Sigma program maturity level.

The fourth hypothesis was not rejected; there was no significant relationship between financial performance (gross profit margin and operating margin) and SMEs and large organizations or manufacturing and non-manufacturing organizations.

The fifth hypothesis was not rejected; there was no significant relationship between financial performance (gross profit margin and operating margin) and program maturity level.

CHAPTER 5

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND OBSERVATIONS

Chapter 5 provides a summary, conclusions and discussion, and recommendations for further research. The first section provides a summary of the problem statement, the purpose of the study, research questions and hypotheses, methodology, analysis, and findings. The second section presents researcher's observations that are not part of the research questions or hypotheses. The third section provides conclusions for the results and a discussion of the study and section four offers recommendations for further research.

Summary

Globalization as well as new human, business, and technology demands require organizations to deliver high quality performance to remain competitive. Quality methods and systems such as Six Sigma can enable alignment with rapidly changing and increasing customer expectations. Six Sigma has been proven by larger manufacturers such as Motorola, GE, and Allied Signal to improve operations and competitiveness. Many large companies are increasing their dependence on SMEs as suppliers and requiring SMEs to also implement Six Sigma to improve quality and reduce costs and prices. The 21st century is also moving quality from manufacturing to non-manufacturing and many characteristics present in manufacturing also exist in non-manufacturing processes. Additionally, Six Sigma within manufacturing organizations has moved from the manufacturing floor to other departments. While there is general agreement that savings opportunities can be found outside of manufacturing, SMEs and non-manufacturers are asking if Six Sigma is a viable option that will produce the same benefits experienced in large manufacturing organizations. Given these factors, what are the relationships between financial performance, organization size, business classification, and program maturity?

Purpose

The purpose of this study was to examine the financial performance of Six Sigma companies and analyze the relevance of the financial performance comparing SMEs versus large companies, manufacturing versus non-manufacturing organizations, and program maturity. In addition the study examined program maturity factors.

Research Questions

Research questions included,

1. What are the relationships inherent in organization size, business classification, and organizational financial performance as related to Six Sigma system maturity?
2. What is the relationship of Six Sigma program success relative to organizational financial performance, organization size, business classification, and program maturity of the Six Sigma system?

Research Hypotheses

Research questions were further developed into the hypotheses. Hypotheses 1-3 relate to program maturity for research question one and Hypotheses 4-5 relate to financial performance for research question one and research question two.

Hypothesis 1: Program Maturity for Organization Size and Business Classification

H_{01}: $\beta j = 0$. There is no statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 2: Program Maturity Factors for Organization Size and Business Classification

H_{02}: $\beta j = 0$. There is no statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a2}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity factors (leadership, customer focus, strategy, project management, Evaluation/Motivation, infrastructure, business results) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 3: Program Maturity for Years of Implementation

H_{03}: $\beta j = 0$. There is no statistically significant relationship between program maturity and years of implementation.

H_{a3}: $\beta j \neq 0$. There is a statistically significant relationship between program maturity and years of implementation.

Hypothesis 4: Financial Performance for Organization Size and Business Classification

H_{04}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

H_{a4}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and organization size (large versus small-to-medium) or business classification (manufacturing versus non-manufacturing).

Hypothesis 5: Financial Performance for Program Maturity Level

H_{05}: $\beta j = 0$. There is no statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

H_{a5}: $\beta j \neq 0$. There is a statistically significant relationship between financial performance (gross profit margin and operating margin) and program maturity (level 1-5).

Methodology

The method of study included an online survey. The research population was the set of all United States SMEs (small-to-medium) and large organizations in manufacturing and non-manufacturing with Six Sigma systems as identified in cooperation with members of the American Society of Quality (ASQ), the iSixSigma organization, and NIST (National Institute of Standards and Technology)/MEP (Manufacturing Extension Partnership). The iSixSigma membership initially identified Six Sigma organizations and NIST/MEP identified additional organizations using Six Sigma systems. ASQ members participating in Six Sigma forums and other individuals within ASQ with publicly disclosed contact information were included in the survey distribution Email. Hoover's, a Dun and Bradstreet Company, public data was used to supplement missing contact information for identified Six Sigma organizations.

An online survey was distributed by Email to the distribution list for data collection. The survey asked quantitative and qualitative questions. Quantitative questions involved demographic and organization information as well as financial data. Qualitative questions were asked to help determine program maturity, which was analyzed quantitatively. Microsoft Excel, SPSS 16.0, Minitab 15, and Qualtrics were used to organize and present statistical analysis data. Regression was utilized to test the significance of relationships between independent and dependent variables.

The Six Sigma survey was used to gather demographic and organizational data, as well as financial performance and program maturity data. The instrument consisted of three parts:

- Part one of the survey included demographic and organization background data to categorize respondent data by organization size and business classification. Data was gathered to understand the respondent function, number of years the organization had used Six Sigma systems, number of Six Sigma projects per year, and positions that support Six Sigma efforts.
- Part two of the survey was concerned with financial performance, including gross profit margin and operating margin for the year 2008. Questions eight and nine asked respondents to enter the values and were given the option to select not applicable or don't know.
- Part three of the survey involved Six Sigma program maturity factors in question ten, which included seven subsets of questions for each program maturity factor.

Factor one was leadership and factor two was customer focus, consisting of two questions each. Factors three through five included strategy, project management, and Evaluation/Motivation respectively, and consisted of four questions for each factor. Factor six, infrastructure, consisted of eleven questions and factor seven, business results, consisted of eight questions. The program maturity questions used a Likert-type rating, ranging from one to five, where five was strongly agree, four was agree, three was disagree, two was strongly disagree, and one was uncertain.

The survey was reviewed and tested by eleven individuals viewed as experts in survey development, statistical survey analysis, or Six Sigma in SMEs and large organizations, as well as manufacturing and non-manufacturing organizations. The online survey was inserted into Qualtrics at the University of Wisconsin-Stout and emailed to the distribution list. The Email text described the purpose of the study, instructions, contact information, Institutional Research Board (IRB) information, and the URL internet link. Emails were successfully sent to a distribution list of 606 individuals.

Data from respondents was stored and reported electronically in the Qualtrics tool. Results were downloaded from Qualtrics to Microsoft Excel, SPSS 16.0, and Minitab 15 for analysis. Qualtrics also provided descriptive statistics for each question. Descriptive statistics and regression were used to analyze the data results. A significance level of 0.05 was established to determine statistical significance of observed values.

Summary of Findings

Survey data was collected from 118 respondents, with 87 respondents associated with SMEs and large organizations in manufacturing and non-manufacturing that utilized Six Sigma.

Responses from the 87 participants were used to answer questions one through four. Responses from 84 participants were used to answer questions five and six, with 80 participants for question seven. Questions eight and nine had 77 responses, however, 14 responses provided usable values for question eight and 12 responses provided usable data for question nine. Responses for question ten varied with 69 participants for question 10.1 and 10.2, and 67 to 68 participants answering questions 10.3 to 10.7.

The first section of the survey asked about demographic and organizational data. Respondents were grouped by organization size (large versus SME) and business classification (manufacturing versus non-manufacturing). The organization size grouping consisted of 48% SME and 52% large organization respondents. The business classification grouping consisted of 83% manufacturing and 17% non-manufacturing respondents. The manufacturing group included 50% SME and 50% large organization respondents. The non-manufacturing group included 40% SME and 60% large organization respondents. Of the large organization respondents, 80% were manufacturing and 20% were non-manufacturing. In the SME group, 86% were manufacturing and 14% were from non-manufacturing organizations. The largest group of respondents worked in the quality function (71%) and held positions either in management (40%) or as certified Six Sigma professionals (33%). The majority of respondents indicated their organizations had utilized Six Sigma 3-5 years (43%), followed by 6-9 years (24%). The most reported number of Six Sigma projects per year varied with 1-5 (42%), 6-9 (21%), and more than 20 (32%).

The second section of the survey reported financial performance (gross profit margin and operating margin). The majority of respondents did not provide financial values to these questions. Gross profit margin responses included 14 (18%) usable responses, six (8%) not applicable, and 55 (71%) don't know responses. Usable gross profit margin values were provided by six SMEs and eight large organizations, eleven manufacturing and three non-manufacturing organizations. Descriptive statistics for gross profit margin indicated a minimum(1.5), maximum(70.0), mean(29.44), SD(17.96), and variance(322.47). Operating margin responses included 12 (16%) usable, six (8%) not applicable, and 58 (75%) don't know responses. Operating margin values were provided by three SMEs and nine large organizations, eight manufacturing and four non-manufacturing organizations. Descriptive statistics for values provided include minimum(-2.9), maximum(17.0), mean(8.21), SD(6.68), and variance(44.58). Results indicated the following:

What is the relationship of Six Sigma program success relative to organizational financial performance, organization size, business classification, and program maturity of the Six Sigma system?

To address financial performance for Research Question 1 and Research Question 2, research hypotheses four and five were tested to evaluate the relationship of Six Sigma program success relative to financial performance, organization size, business classification, and program maturity level.

- The fourth hypothesis was not rejected; there was no significant relationship between financial performance (gross profit margin and operating margin) and SMEs and large organization or manufacturing and non-manufacturing organizations.
- The fifth hypothesis was not rejected; there was no significant relationship between financial performance (gross profit margin and operating margin) and program maturity level.

The third section of the survey addressed Six Sigma program maturity for Research Question 1 by a set of seven categories and questions by category included in Survey Question 10. Categories included Six Sigma leadership, customer focus, Six Sigma strategy, Six Sigma project management, Evaluation/Motivation, Six Sigma infrastructure, and business results. Responses to Question 10 were based on respondent perceptions using a Likert-type rating of one through five. A rating of five was strongly agree, four was agree, three was disagree, two was strongly disagree, and one was uncertain. Responses for question ten varied with 69 participants for question 10.1 and 10.2, and 67 to 68 participants answering questions 10.3 to 10.7. The majority of respondents (72%) ranked their organizations at program maturity level 4 out of 5, with 5 being best. Results indicated the following:

What are the relationships inherent in organization size, business classification, and organizational financial performance as related to Six Sigma system maturity?

To address program maturity for Research Question 1, hypotheses one, two, and three were tested to determine the relationships in organization size and business classification as related to Six Sigma system maturity. Hypotheses four and five were tested to determine the relationships in organization size, business classification, and organizational financial performance as related to Six Sigma system maturity.

- The first null hypothesis was not rejected; there was no significant relationship between program maturity and SMEs and large organizations or manufacturing and non-manufacturing organizations.
- The second null hypothesis was not rejected; there was no significant relationship between program maturity factors and SMEs and large organizations or manufacturing and non-manufacturing organizations.

- The third null hypothesis was not rejected; there was no significant relationship between program maturity and years of implementation.
- The fourth hypothesis was not rejected; there was no significant relationship between financial performance (gross profit margin and operating margin) and SMEs and large organization or manufacturing and non-manufacturing organizations.
- The fifth hypothesis was not rejected; there was no significant relationship between financial performance (gross profit margin and operating margin) and program maturity level.

Researcher's Observations

This section is provided to relate observations by the researcher not part of the study research questions or hypotheses. In addition to the online survey respondents, the researcher received 22 Emails and three phone calls regarding the study. These communications may offer insight into related topics or future research. Nine individuals indicated that they don't "fit the mold" and would be outliers in the study. Five communications indicated discomfort with sharing financial data, the organization was privately held, the information was confidential, leadership did not authorize sharing information, or the information could not be shared because their organization might be accused of insider trading. An additional four communications came from Six Sigma certified professionals who would like to participate, but were currently unemployed. One individual said the project sounded very interesting, but was needed two years ago when they were employed.

Six individuals provided other feedback. There was concern regarding the use of a formal Six Sigma program rather than simply utilizing Six Sigma methods and tools. In some cases, the term Six Sigma was not used and viewed as a "buzzword." One individual indicated that Six Sigma required significant program infrastructure to ensure proper launching and sustainability. This person was convinced that many organizations lack the foundation to start the process properly and, consequently, did not achieve the expected results. Mergers and acquisitions also caused failure in Six Sigma change initiatives.

Several individuals indicated Six Sigma projects no longer existed, but Six Sigma tools and methodology were incorporated into project work as appropriate. Additionally, savings data attributed to Six Sigma was no longer gathered, but it was assumed that any savings reported were obtained using Six Sigma where applicable. Another individual indicated that Six Sigma was not a silver bullet and implementation should occur slowly, not in a program. Training on Six Sigma methods was informal and conducted as part of the job. Also, companies today were not advanced enough to use difficult statistical and Six Sigma techniques. As a result, green belts and smaller projects were more effective at SMEs. Finally, involvement and empowerment were important, but should be kept within defined boundaries.

In summary, it appears there is an appetite to improve quality and Six Sigma methods are part of the equation, but not the entire equation. There was also interest in the program maturity part of the study and several individuals requested to see the results.

Conclusions and Discussion

Globalization as well as new human, business, and technology demands require organizations to deliver high quality performance to remain competitive. Quality methods and systems such as Six Sigma can enable organizations to remain competitive with rapidly changing and increasing customer expectations. Six Sigma has been proven by larger manufacturers such as Motorola, GE, and Allied Signal to improve operations and competitiveness. As large companies increase their dependence on SMEs as suppliers and address large company requests to implement Six Sigma to improve quality and reduce costs and prices to remain competitive. The 21st century is also moving quality from manufacturing to non-manufacturing and many characteristics present in manufacturing also exist in non-manufacturing processes. Additionally, Six Sigma within manufacturing organizations has moved from the manufacturing floor to other departments.

An empirical study of the impact of Six Sigma methodology on organization financial performance showed a statistically significant influence on net income, but no statistical significance for return on assets or stock price (Ayeni, 2004). An analysis of Six Sigma at small versus large manufacturing companies showed challenges for all organizations in deploying Six Sigma regardless of size (Adeyemi, 2004). Additionally, the study found that small companies had the capacity to implement Six Sigma programs successfully and the benefits outweighed the costs.

Research question one asked about the relationships of Six Sigma program success relative to organizational financial performance, organization size, business classification, and program maturity of Six Sigma systems. Financial performance (gross profit margin, operating margin) relationships with organization size, business classification, and program maturity level were not significant. The sample size was small, so conclusions should not be made based on these results. Interesting statistics related to financial performance occurred with regard to the business results factor for program maturity. While the majority of respondents did not know gross profit margin or operating margin, when asked if financial results and returns on investment for Six Sigma projects were positive, results indicated that 13% strongly agree, 68% agree, 11% disagree, 3% strongly disagree, and 10% were uncertain.

Pyzdek (2003), George (2002), and Evans and Lindsay (2005) are recognized experts in Six Sigma implementation and sustainability. The experts agreed that key success factors include involved leadership, strategic planning, tracking business goals with results, providing continuous reinforcement and rewards, training, and infrastructure. A study of critical success factors of Six Sigma implementation and the impact on operations performance indicated leadership and statistical tool usage were critical success factors (Lee, 2003). However, the study indicated no difference in the critical success factors of Six Sigma in large companies when compared to SMEs. Further, He developed a maturity model where a total maturity score was calculated to enable evaluation of continuous improvement efforts utilizing Six Sigma methods for 20 companies in China.

Research question two asked about the relationships inherent in organization size, business classification, and organizational financial performance as related to Six Sigma system maturity. Findings from the 68 usable program maturity respondents of this study, with 55 manufacturing and 13 non-manufacturing companies, as well as 34 SMEs and 34 large organizations, showed no apparent relationship between overall Six Sigma program maturity, program maturity level, and organization size or business classification. Similarly, there was no apparent relationship between the seven program maturity factors and organization size or business classification. Study results indicated the majority of survey respondents ranked themselves at level 4 (72%) for program maturity.

While the overall survey response rate was 19%, there was a limitation with the response rate and potential bias for the 81% that did not respond. It is not known if the 81% did not respond because their Six Sigma efforts were unsuccessful or if success was so great there was no desire to be involved in the study.

Further, the statistical results indicated large residuals in addition to negative R^2 values. This could potentially indicate the variables in the model were inappropriate and other independent variables might be more important. Perhaps organization size and business class are becoming unimportant with partnerships, alliances, and supply chain management. Results showed that 45% agreed or strongly agreed and 31% disagreed or strongly disagreed that the efforts improved supply chain results. However, 73% disagreed or strongly disagreed that Six Sigma was effectively utilized throughout the organization's supply chain. Additionally, 63% disagreed or strongly disagreed and 25% agreed or strongly agreed that Six Sigma methods are effectively utilized with strategic partners and alliances.

Finally, the study survey results indicated that Six Sigma systems were apparently more widespread in manufacturing (83%) than non-manufacturing (17%). Also, Six Sigma systems were apparently utilized in SMEs (48%) nearly as frequently as large organizations (52%). The difference, however, could be attributed to willingness of organizations and individuals from each of the categories to participate in the study.

Recommendations for Further Research

It is possible that the results of this study may be used to further the understanding of Six Sigma in terms of the relationships between financial performance, organization size, business classification, and program maturity. The financial performance results are useful to understand for making decisions about Six Sigma systems, but limited due to the confidential nature of financial data. This was especially true for private organizations, and SMEs were in many cases private. The program maturity factors and levels as related to financial performance, organization size, and business classification could be helpful to continuously improve Six

Sigma systems and organization financial performance. The following items are recommendations for further study.

- This study should be replicated with a focused set of respondents over a longer period of time. A relationship should be developed with a smaller, but balanced sample of companies to earn trust and obtain adequate financial performance data to enable meaningful statistical analysis. A larger population of SMEs and non-manufacturing organizations would enable a better comparison by organization size and business classification.
- The program maturity factors could be developed into a standard model to be used by organizations for continuous improvement purposes. The factors are similar to other quality systems such as Malcolm Baldrige and the Software Engineering Institute's Capability Maturity Model. Developing the model further for Six Sigma and expanding it into other areas of quality such as Lean may help improve U.S. global competitiveness.
- The financial piece of the study could be conducted on public companies where financial data was available from Hoover's Company Information or publicly available company reports. This could address relationships between manufacturers and non-manufacturers in profit organizations. However, limitations remain for privately held organizations, which include many SMEs.
- The organization size and business classification categories may no longer apply as organizations create partnerships and alliances in supply chain management. This aspect could be further studied to gain a better understanding of the impact of

relationships between organizations that rely very closely upon one another to compete in the global environment.

Understanding the relationships between financial performance, organization size, business classification, and program maturity can be important in making decisions about pursuing, implementing, and sustaining Six Sigma systems. Proven quality methods such as Six Sigma have the potential to provide improved bottom line results and enabled decision making for organization leaders. This research was built upon previous research and experience from organizations with Six Sigma systems to provide information and insight for future research.

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APPENDIX A: SIX SIGMA SURVEY

Hello,
Your organization has been recognized by ASQ, iSixSigma, or NIST/MEP membership as utilizing Six Sigma methods. As a colleague involved in Six Sigma efforts, you are invited to participate in a research study to understand relationships in the financial performance, organization size, business classification, and program maturity of United States organizations utilizing Six Sigma methods and systems. The study is being conducted by Diane Olson and Dr. John Sinn as part of a Ph.D. dissertation in Technology Management at Indiana State University.

There are no known risks if you decide to participate in this research study, nor are there any costs to you for participating in the study. The information you provide will be used to help understand the relationship between Six Sigma and other organizational factors. The information collected may not benefit you directly, but the information learned in this study should provide more general benefits to organizations and research.

Confidentiality: Survey results will be anonymous. Your name or organization name will not be included on any documents. Individuals from the Institutional Review Board may inspect these records. Should the data be published, no individual information will be disclosed.

Statement of Consent: Your participation in this study is voluntary. By completing this survey you agree to participate in the project entitled, A Study of the Relationships in Financial Performance, Organization Size, Business Classification, and Program Maturity of Six Sigma Systems.

Right to Withdraw: You are free to decline to answer any particular question you do not wish to answer for any reason. Once you submit your response, the data cannot be linked to you and cannot be withdrawn.

Investigator:	*Research Sponsor*:
Diane Olson, ph. 715-232-5129	Dr. John Sinn, ph. 419-372-2531
olsondi@uwstout.edu	jwsinn@bgnet.bgsu.edu

The Indiana State University IRB has determined this study to be exempt from IRB oversight.

The electronic survey will take approximately 10 minutes. Your experience and knowledge are essential to the research results. Thank you in advance for your participation in this survey.

Linkage from Qualtrics Internet Survey Tool

Please delete this Email message after you have completed the survey. If you have any questions about your rights as a research subject or if you feel you've been placed at risk, you may contact the Indiana State University Institutional Review Board (IRB) by mail at Indiana State

University, Office of Sponsored Programs, Terre Haute, IN, 47809, by phone at (812) 237-8217, or by email at irb@indstate.edu.

Note:
This research can be referenced by Indiana State University IRB No. 10-100.
This research has been approved by the UW-Stout IRB as required by the Code of Federal regulations Title 45 Part 46, contact Susan Foxwell, email FoxwellS@uwstout.edu.

Demographic Data

1. Number of employees in your organization (for demographic verification purposes).

   - ☐ <= 2500 employees (small-to-medium)
   - ☐ > 2500 employees (large)

2. Your organization's primary business classification (for demographic verification purposes).

   - ☐ Manufacturing

   - ☐ Non-manufacturing (please specify non-manufacturing classification)

     - ☐ Agriculture, Forestry, Fishing
     - ☐ Mining
     - ☐ Construction
     - ☐ Transportation, Communication, Electric, Gas, Sanitary Services
     - ☐ Wholesale Trade
     - ☐ Retail Trade
     - ☐ Finance, Insurance, Real Estate
     - ☐ Services
     - ☐ Public Administration
     - ☐ Other (please specify) ______________________

3. Your department or function:

   - ☐ Executive
   - ☐ Research and Development
   - ☐ Production, Operations
   - ☐ Quality
   - ☐ Finance, Accounting
   - ☐ Supply Chain Management, Purchasing
   - ☐ Customer Service
   - ☐ Other (please specify) ____________________

4. Your position:

   - ☐ Management
   - ☐ Six Sigma Master Black Belt
   - ☐ Six Sigma Black Belt
   - ☐ Six Sigma Green Belt
   - ☐ Other (please specify) ________________________________

5. Number of years Six Sigma methods and systems have been utilized in your organization:

   - ☐ Less than 1 year
   - ☐ 1 – 2 years
   - ☐ 3 – 5 years
   - ☐ 6 – 9 years
   - ☐ 10 – 14 years
   - ☐ 15 – 19 years
   - ☐ 20+ years

6. Number of projects per year that utilize Six Sigma methods:

   - ☐ 1 – 5
   - ☐ 6 – 9
   - ☐ 10 – 19
   - ☐ 20+

7. Positions and Six Sigma certified employees that directly support Six Sigma efforts (check all that apply):

   - ☐ Champions
   - ☐ Executive Sponsors
   - ☐ Yellow Belts
   - ☐ Green Belts
   - ☐ Black Belts
   - ☐ Master Black Belts

Financial Performance

8. Please enter your organization's Gross Profit Margin for the year 2008.

    - ☐ Gross Profit Margin: Gross Profit as a Percent of Sales (ie. 12.5) _____________
    - ☐ Not Applicable
    - ☐ Don't Know

9. Please enter your organization's Operating Margin for the year 2008.

    - ☐ Operating Margin: Operating Income as a Percent of Sales (ie. 5.2) _____________
    - ☐ Not Applicable
    - ☐ Don't Know

Six Sigma Program Maturity

10. Six Sigma Maturity Level Assessment. Please rate the following items.

    Ratings for each statement response will be scored using the following Likert-type rating.

    - Strongly Agree (5)
    - Agree (4)
    - Disagree (3)
    - Strongly Disagree (2)
    - Uncertain (1)

10.1 Six Sigma Leadership
- 10.1.1 Organization vision and core values include Six Sigma continuing efforts.
- 10.1.2 Executive Leadership visibly participates in Six Sigma efforts.

10.2 Customer Focus
- 10.2.1 Projects utilizing Six Sigma methods and systems are selected based on the Voice-of-the-Customer (VOC).
- 10.2.2 Projects utilizing Six Sigma methods and systems use customer satisfaction metrics and measurements to provide feedback and evaluate continuous improvement efforts.

10.3 Six Sigma Strategy
- 10.3.1 A Six Sigma strategy development process is well-defined, documented, and followed.
- 10.3.2 Six Sigma efforts align with organizational strategies.
- 10.3.3 A process to make decisions regarding when to utilize Six Sigma methods and systems is well-defined, documented, and followed.

10.3.4 Key performance metrics that include Six Sigma efforts are well-defined, documented, and followed.

10.4 Six Sigma Project Management

10.4.1 A decision process to identify and plan projects to utilize Six Sigma methods and systems is well-defined, documented, and followed.
10.4.2 Project management procedures and tools for projects utilizing Six Sigma methods and systems are well-defined, documented, and utilized.
10.4.3 Project tracking and oversight for projects utilizing Six Sigma methods and systems is well-defined, documented, and utilized.
10.4.4 Project evaluation metrics for projects utilizing Six Sigma methods and systems is well-defined, documented, and utilized.

10.5 Evaluation/Motivation

10.5.1 Team performance assessment processes are well-defined, documented, and followed.
10.5.2 Performance metrics for employees responsible for deploying and maintaining Six Sigma methods and systems is well-defined, documented, and followed.
10.5.3 A reward and recognition process for employees working on Six Sigma efforts is well-defined, documented, and followed.
10.5.4 Career development paths for employees responsible for Six Sigma efforts are well-defined, documented, and followed.

10.6 Six Sigma Infrastructure

10.6.1 Six Sigma methods, systems, tools, and procedures are well-defined, documented, and followed.
10.6.2 The Six Sigma training system is effective.
10.6.3 The Six Sigma body of knowledge is well-known throughout the organization.
10.6.4 Communication related to Six Sigma strategies, plans, and outcomes is effective.
10.6.5 All employees in the organization are involved in Six Sigma strategies, plans, and related projects utilizing Six Sigma methods.
10.6.6 The quality and availability of Six Sigma results data is effective for improvement purposes.
10.6.7 The information technology system related to Six Sigma data is effective.
10.6.8 The support for the information technology system related to Six Sigma data is effective.
10.6.9 Knowledge management and sharing of Six Sigma data is effective.
10.6.10 Six Sigma methods and systems are utilized effectively throughout the organization's supply chain.
10.6.11 Six Sigma methods and systems are utilized effectively with strategic partners and alliances.

10.7 Business Results

10.7.1 Internal customers are satisfied with Six Sigma project results.
10.7.2 External customers are satisfied with Six Sigma project results.
10.7.3 Financial results and returns on investment for Six Sigma projects are positive.
10.7.4 Six Sigma efforts cultivate talent development of employees.
10.7.5 Six Sigma efforts positively impact employee satisfaction.
10.7.6 Six Sigma projects positively contribute to internal business process improvements.
10.7.7 Six Sigma projects and efforts improve supply chain results.
10.7.8 Six Sigma projects and efforts improve the corporate culture.

Thank you for the time you have taken to complete this survey.

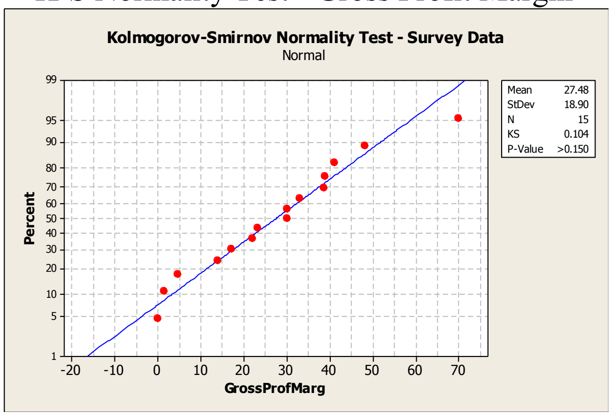
APPENDIX B: SIX SIGMA PROGRAM MATURITY LEVEL CALCULATIONS

Question	Level 1	Level 1 Total	Level 2	Level 2 Total	Level 3	Level 3 Total	Level 4	Level 4 Total	Level 5	Level 5 Total
10.1		2		4		6		8		10
10.1.1	1		2		3		4		5	
10.1.2	1		2		3		4		5	
10.2		2		4		6		8		10
10.2.1	1		2		3		4		5	
10.2.2	1		2		3		4		5	
10.3		4		8		12		16		20
10.3.1	1		2		3		4		5	
10.3.2	1		2		3		4		5	
10.3.3	1		2		3		4		5	
10.3.4	1		2		3		4		5	
10.4		4		8		12		16		20
10.4.1	1		2		3		4		5	
10.4.2	1		2		3		4		5	
10.4.3	1		2		3		4		5	
10.4.4	1		2		3		4		5	
10.5		4		8		12		16		20
10.5.1	1		2		3		4		5	
10.5.2	1		2		3		4		5	
10.5.3	1		2		3		4		5	
10.5.4	1		2		3		4		5	
10.6		11		22		33		44		55
10.6.1	1		2		3		4		5	
10.6.2	1		2		3		4		5	
10.6.3	1		2		3		4		5	
10.6.4	1		2		3		4		5	
10.6.5	1		2		3		4		5	
10.6.6	1		2		3		4		5	
10.6.7	1		2		3		4		5	
10.6.8	1		2		3		4		5	
10.6.9	1		2		3		4		5	
10.6.10	1		2		3		4		5	
10.6.11	1		2		3		4		5	
10.7		8		16		24		32		40
10.7.1	1		2		3		4		5	
10.7.2	1		2		3		4		5	
10.7.3	1		2		3		4		5	
10.7.4	1		2		3		4		5	
10.7.5	1		2		3		4		5	
10.7.6	1		2		3		4		5	
10.7.7	1		2		3		4		5	
10.7.8	1		2		3		4		5	
		35		70		105		140		175

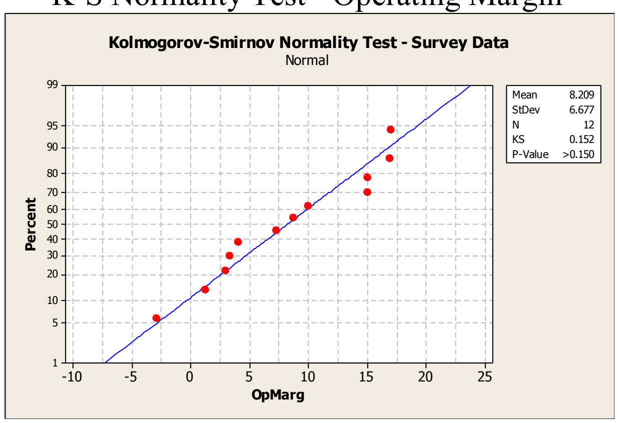
Level 1 = 0 – 35
Level 2 = 36 – 70
Level 3 = 71 – 105
Level 4 = 106 – 140
Level 5 = 141 – 175

APPENDIX C: KOLMOGOROV-SMIRNOV NORMALITY TESTS

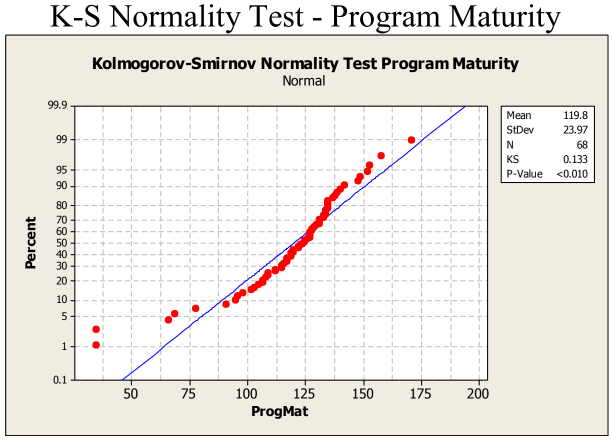
K-S Normality Test - Gross Profit Margin



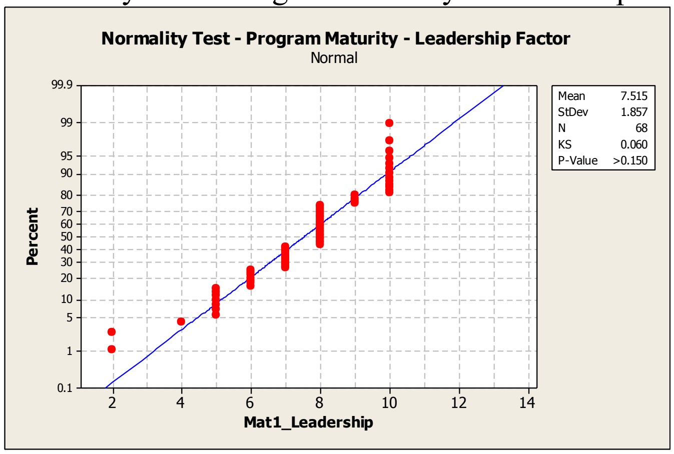
K-S Normality Test - Operating Margin



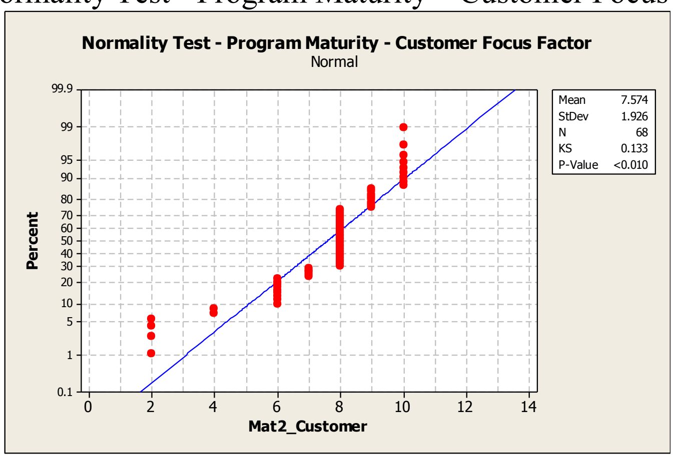
K-S Normality Test - Program Maturity



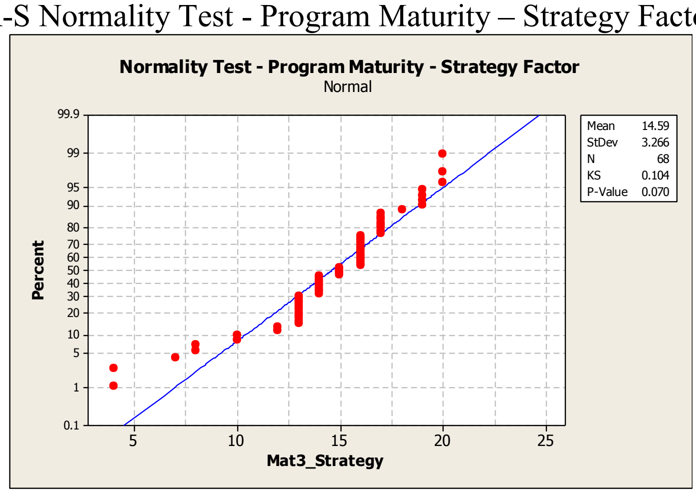
K-S Normality Test - Program Maturity – Leadership Factor



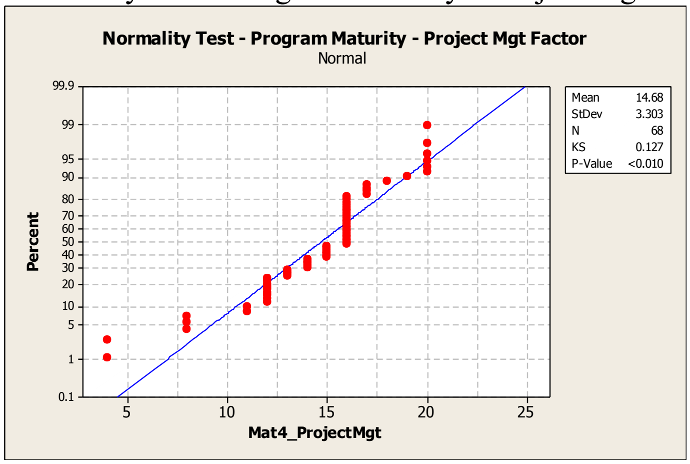
K-S Normality Test - Program Maturity – Customer Focus Factor



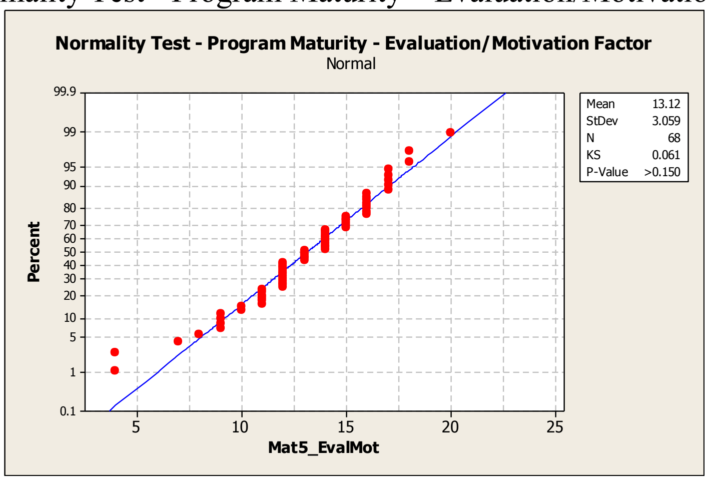
K-S Normality Test - Program Maturity – Strategy Factor



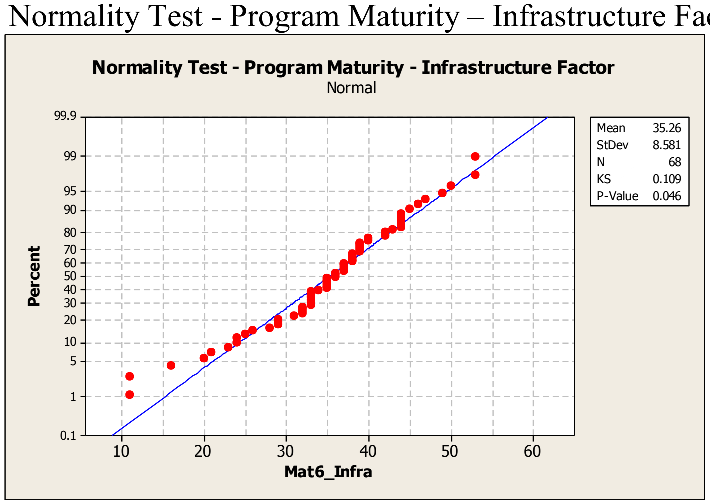
K-S Normality Test - Program Maturity – Project Mgt Factor



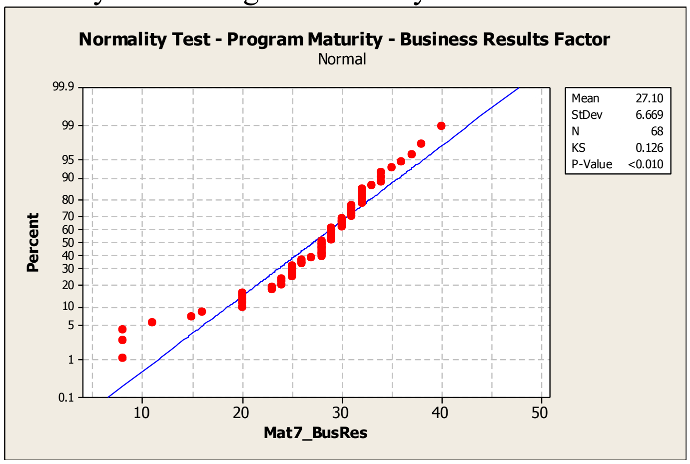
K-S Normality Test - Program Maturity – Evaluation/Motivation Factor



K-S Normality Test - Program Maturity – Infrastructure Factor

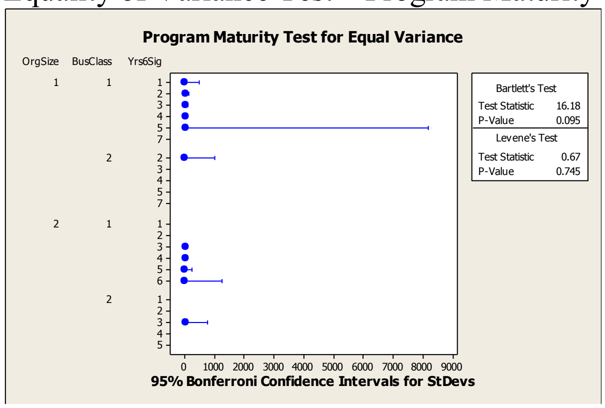


K-S Normality Test - Program Maturity – Business Results Factor

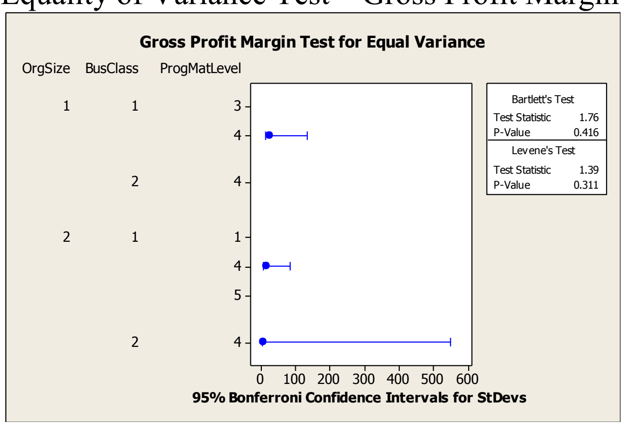


APPENDIX D: TESTS FOR EQUAL VARIANCES

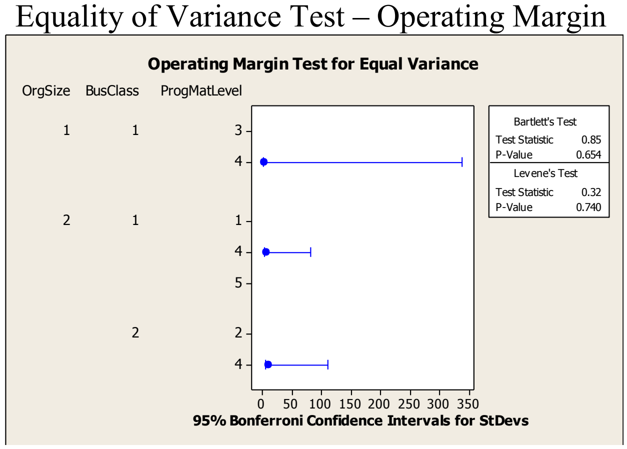
Equality of Variance Test – Program Maturity



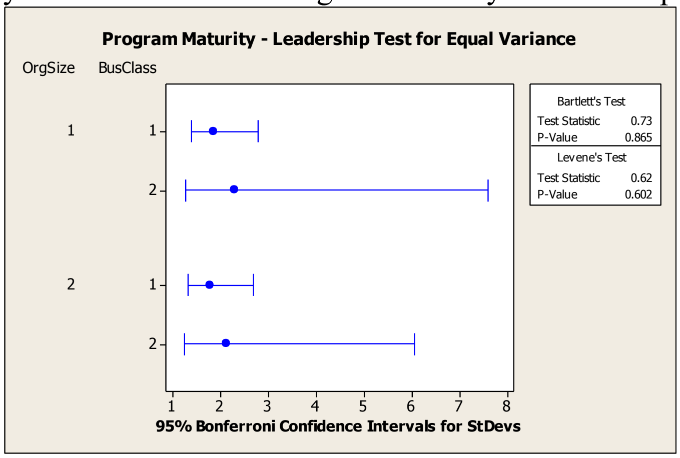
Equality of Variance Test – Gross Profit Margin



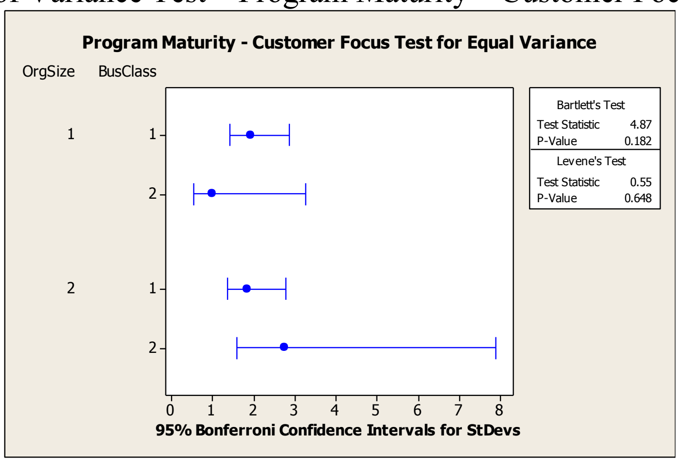
Equality of Variance Test – Operating Margin



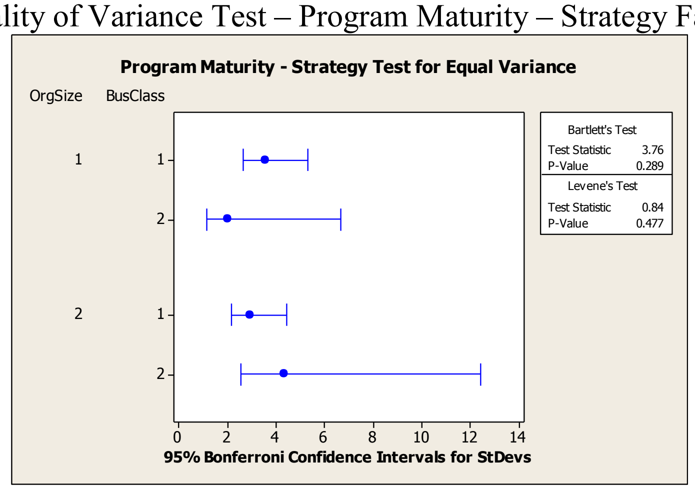
Equality of Variance Test – Program Maturity – Leadership Factor



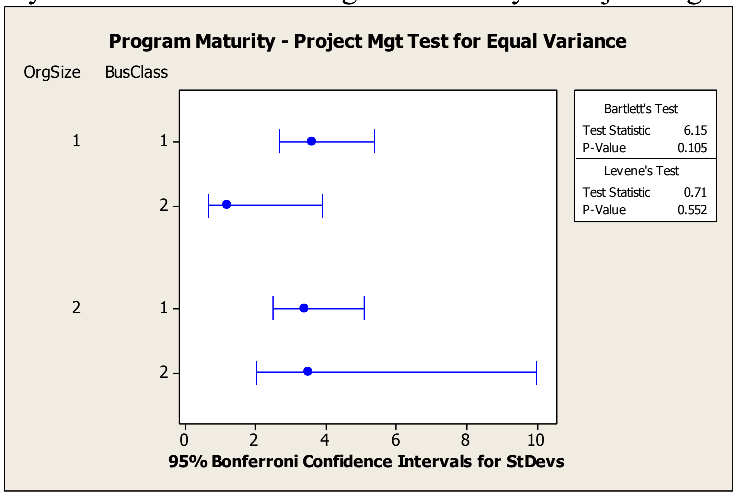
Equality of Variance Test – Program Maturity – Customer Focus Factor



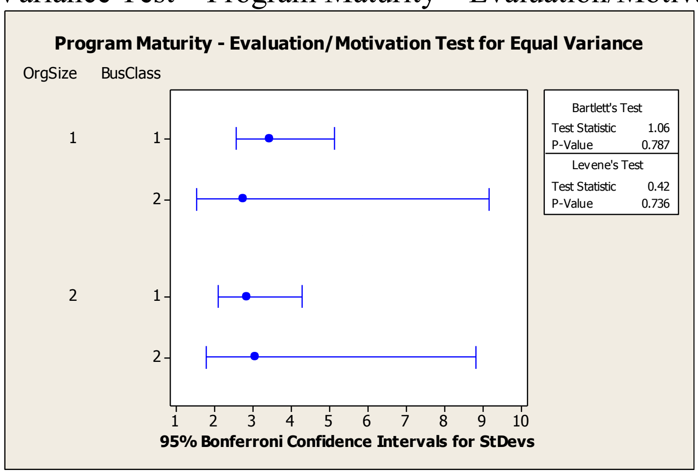
Equality of Variance Test – Program Maturity – Strategy Factor



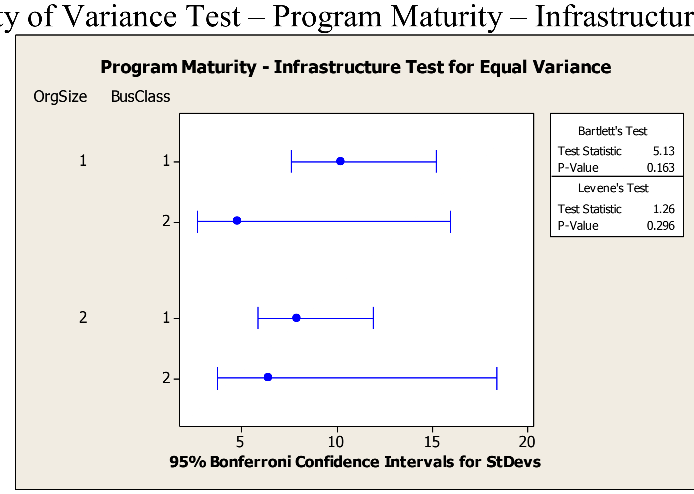
Equality of Variance Test – Program Maturity – Project Mgt Factor



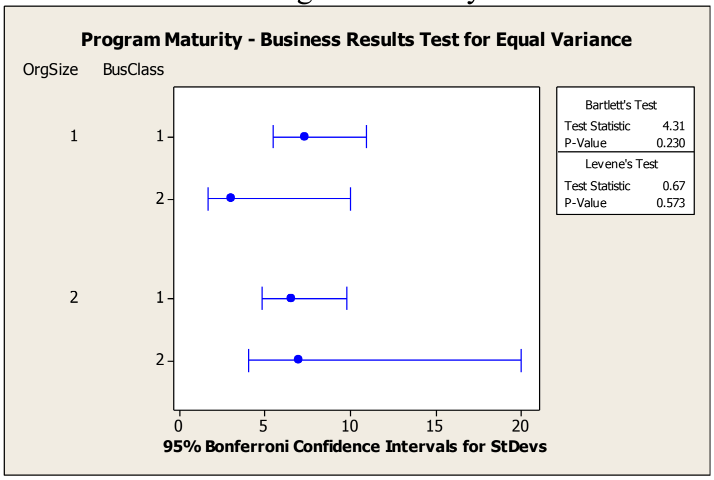
Equality of Variance Test – Program Maturity – Evaluation/Motivation Factor



Equality of Variance Test – Program Maturity – Infrastructure Factor



Equality of Variance Test – Program Maturity – Business Results Factor



APPENDIX E: STATISTICS

Program Maturity (Hypothesis 1, Hypothesis 3) Statistical Results (1 of 2)

Descriptive Statistics

	Mean	Std. Deviation	N
Program Maturity	119.8382	23.96989	68
Organization Size	1.50	.504	68
Business Classification	1.19	.396	68
Years in Six Sigma	3.43	1.273	68

Correlations

		Program Maturity	Organization Size	Business Classification	Years in Six Sigma
Pearson Correlation	Program Maturity	1.000	-.035	.039	.171
	Organization Size	-.035	1.000	.037	.058
	Business Classification	.039	.037	1.000	-.016
	Years in Six Sigma	.171	.058	-.016	1.000
Sig. (1-tailed)	Program Maturity	.	.388	.375	.082
	Organization Size	.388	.	.381	.319
	Business Classification	.375	.381	.	.448
	Years in Six Sigma	.082	.319	.448	.
N	Program Maturity	68	68	68	68
	Organization Size	68	68	68	68
	Business Classification	68	68	68	68
	Years in Six Sigma	68	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.182[a]	.033	-.012	24.117	2.070

a. Predictors: (Constant), Years in Six Sigma, Business Classification, Organization Size

b. Dependent Variable: Program Maturity

Program Maturity (Hypothesis 1, Hypothesis 3) Statistical Results (2 of 2)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1272.427	3	424.142	.729	.538[a]
	Residual	37222.794	64	581.606		
	Total	38495.221	67			

a. Predictors: (Constant), Years in Six Sigma, Business Classification, Organization Size

b. Dependent Variable: Program Maturity

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations
		B	Std. Error	Beta			Zero-order
1	(Constant)	108.800	14.697		7.403	.000	
	Organization Size	-2.236	5.863	-.047	-.381	.704	-.035
	Business Classification	2.663	7.444	.044	.358	.722	.039
	Years in Six Sigma	3.275	2.318	.174	1.413	.163	.171

a. Dependent Variable: Program Maturity

Coefficients[a]

Model		Correlations		Collinearity Statistics	
		Partial	Part	Tolerance	VIF
1	(Constant)				
	Organization Size	-.048	-.047	.995	1.005
	Business Classification	.045	.044	.998	1.002
	Years in Six Sigma	.174	.174	.996	1.004

a. Dependent Variable: Program Maturity

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	Organization Size	Business Classification	Years in Six Sigma
1	1	3.764	1.000	.00	.01	.01	.01
	2	.112	5.785	.00	.04	.26	.70
	3	.094	6.315	.00	.66	.35	.05
	4	.029	11.333	1.00	.30	.38	.25

a. Dependent Variable: Program Maturity

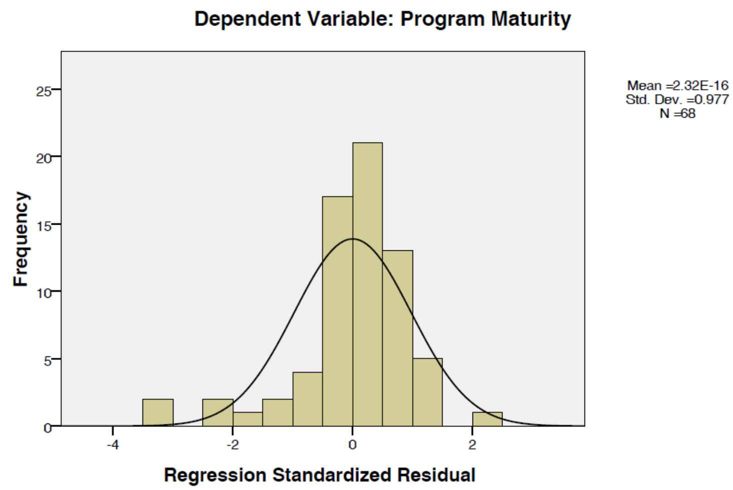
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	110.2651	134.8125	119.8382	4.35792	68
Residual	-84.05074	55.22390	.00000	23.57041	68
Std. Predicted Value	-2.197	3.436	.000	1.000	68
Std. Residual	-3.485	2.290	.000	.977	68

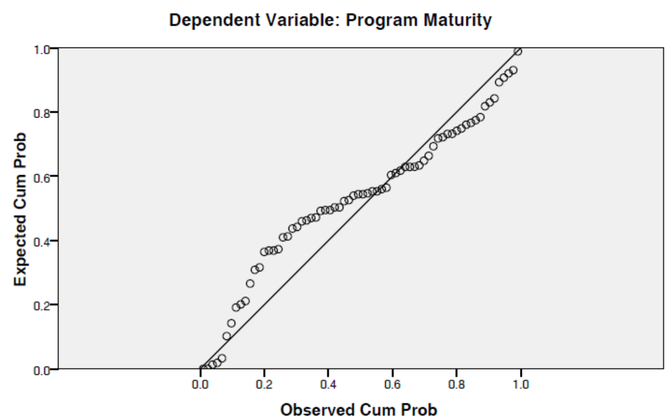
a. Dependent Variable: Program Maturity

Program Maturity (Hypothesis 1, Hypothesis 3) Charts/Plots

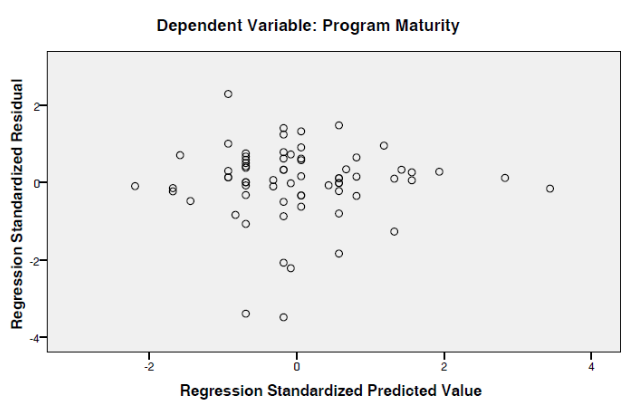
Histogram



Normal P-P Plot of Regression Standardized Residual



Scatterplot



Program Maturity Factor 1 - Leadership (Hypothesis 2) Statistical Results

Correlations

		Mat1_ Leadership	Organization Size	Business Classification
Pearson Correlation	Mat1_Leadership	1.000	.008	.006
	Organization Size	.008	1.000	.037
	Business Classification	.006	.037	1.000
Sig. (1-tailed)	Mat1_Leadership	.	.474	.480
	Organization Size	.474	.	.381
	Business Classification	.480	.381	.
N	Mat1_Leadership	68	68	68
	Organization Size	68	68	68
	Business Classification	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.010[a]	.000	-.031	1.885	.000	.003	2	65

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat1_Leadership

Model Summary[b]

Model	Change Statistics	Durbin-Watson
	Sig. F Change	
1	.997	1.558

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat1_Leadership

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.023	2	.011	.003	.997[a]
	Residual	230.962	65	3.553		
	Total	230.985	67			

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat1_Leadership

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B
		B	Std. Error	Beta			Lower Bound
1	(Constant)	7.438	.984		7.561	.000	5.474
	Organization Size	.029	.458	.008	.062	.950	-.885
	Business Classification	.028	.582	.006	.048	.962	-1.134

a. Dependent Variable: Mat1_Leadership

Coefficients[a]

Model		95% Confidence Interval for B	Correlations		
		Upper Bound	Zero-order	Partial	Part
1	(Constant)	9.403			
	Organization Size	.942	.008	.008	.008
	Business Classification	1.190	.006	.006	.006

a. Dependent Variable: Mat1_Leadership

Program Maturity Factor 2 - Customer Focus (Hypothesis 2) Statistical Results

Correlations

		Mat2_ Customer	Organization Size	Business Classification
Pearson Correlation	Mat2_Customer	1.000	-.131	.108
	Organization Size	-.131	1.000	.037
	Business Classification	.108	.037	1.000
Sig. (1-tailed)	Mat2_Customer	.	.144	.189
	Organization Size	.144	.	.381
	Business Classification	.189	.381	.
N	Mat2_Customer	68	68	68
	Organization Size	68	68	68
	Business Classification	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.173[a]	.030	.000	1.926	.030	1.004	2	65

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat2_Customer

Model Summary[b]

Model	Change Statistics	Durbin-Watson
	Sig. F Change	
1	.372	2.143

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat2_Customer

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.447	2	3.724	1.004	.372[a]
	Residual	241.185	65	3.711		
	Total	248.632	67			

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat2_Customer

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B
		B	Std. Error	Beta			Lower Bound
1	(Constant)	7.691	1.005		7.650	.000	5.683
	Organization Size	-.516	.468	-.135	-1.104	.274	-1.450
	Business Classification	.552	.594	.113	.928	.357	-.635

a. Dependent Variable: Mat2_Customer

Coefficients[a]

Model		95% Confidence Interval for B	Correlations		
		Upper Bound	Zero-order	Partial	Part
1	(Constant)	9.698			
	Organization Size	.417	-.131	-.136	-.135
	Business Classification	1.739	.108	.114	.113

a. Dependent Variable: Mat2_Customer

Program Maturity Factor 3 - Strategy (Hypothesis 2) Statistical Results

Correlations

		Mat3_Strategy	Organization Size	Business Classification
Pearson Correlation	Mat3_Strategy	1.000	-.091	.016
	Organization Size	-.091	1.000	.037
	Business Classification	.016	.037	1.000
Sig. (1-tailed)	Mat3_Strategy	.	.231	.450
	Organization Size	.231	.	.381
	Business Classification	.450	.381	.
N	Mat3_Strategy	68	68	68
	Organization Size	68	68	68
	Business Classification	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.093[a]	.009	-.022	3.301	.009	.282	2	65

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat3_Strategy

Model Summary[b]

Model	Change Statistics	Durbin-Watson
	Sig. F Change	
1	.755	1.725

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat3_Strategy

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.141	2	3.070	.282	.755[a]
	Residual	708.330	65	10.897		
	Total	714.471	67			

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat3_Strategy

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B
		B	Std. Error	Beta			Lower Bound
1	(Constant)	15.291	1.723		8.875	.000	11.850
	Organization Size	-.593	.801	-.091	-.740	.462	-2.193
	Business Classification	.157	1.019	.019	.154	.878	-1.878

a. Dependent Variable: Mat3_Strategy

Coefficients[a]

Model		95% Confidence Interval for B	Correlations		
		Upper Bound	Zero-order	Partial	Part
1	(Constant)	18.731			
	Organization Size	1.007	-.091	-.091	-.091
	Business Classification	2.191	.016	.019	.019

a. Dependent Variable: Mat3_Strategy

Program Maturity Factor 4 – Project Management (Hypothesis 2) Statistical Results

Correlations

		Mat4_ProjMgt	Organization Size	Business Classification
Pearson Correlation	Mat4_ProjMgt	1.000	.027	.002
	Organization Size	.027	1.000	.037
	Business Classification	.002	.037	1.000
Sig. (1-tailed)	Mat4_ProjMgt	.	.414	.492
	Organization Size	.414	.	.381
	Business Classification	.492	.381	.
N	Mat4_ProjMgt	68	68	68
	Organization Size	68	68	68
	Business Classification	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.027[a]	.001	-.030	3.352	.001	.024	2	65

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat4_ProjMgt

Model Summary[b]

Model	Change Statistics	Durbin-Watson
	Sig. F Change	
1	.977	1.943

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat4_ProjMgt

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.531	2	.265	.024	.977[a]
	Residual	730.352	65	11.236		
	Total	730.882	67			

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat4_ProjMgt

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B
		B	Std. Error	Beta			Lower Bound
1	(Constant)	14.399	1.749		8.231	.000	10.905
	Organization Size	.176	.814	.027	.217	.829	-1.449
	Business Classification	.011	1.034	.001	.011	.991	-2.055

a. Dependent Variable: Mat4_ProjMgt

Coefficients[a]

Model		95% Confidence Interval for B	Correlations		
		Upper Bound	Zero-order	Partial	Part
1	(Constant)	17.893			
	Organization Size	1.801	.027	.027	.027
	Business Classification	2.077	.002	.001	.001

a. Dependent Variable: Mat4_ProjMgt

Program Maturity Factor 5 – Evaluation/Motivation (Hypothesis 2) Statistical Results

Correlations

		Mat5_Eval_Motivation	Organization Size	Business Classification
Pearson Correlation	Mat5_Eval_Motivation	1.000	.010	-.007
	Organization Size	.010	1.000	.037
	Business Classification	-.007	.037	1.000
Sig. (1-tailed)	Mat5_Eval_Motivation	.	.469	.479
	Organization Size	.469	.	.381
	Business Classification	.479	.381	.
N	Mat5_Eval_Motivation	68	68	68
	Organization Size	68	68	68
	Business Classification	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.012[a]	.000	-.031	3.106	.000	.005	2	65

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat5_Eval_Motivation

Model Summary[b]

Model	Change Statistics	Durbin-Watson
	Sig. F Change	
1	.995	2.014

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat5_Eval_Motivation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.089	2	.044	.005	.995[a]
	Residual	626.970	65	9.646		
	Total	627.059	67			

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat5_Eval_Motivation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B
		B	Std. Error	Beta			Lower Bound
1	(Constant)	13.090	1.621		8.076	.000	9.853
	Organization Size	.060	.754	.010	.080	.936	-1.445
	Business Classification	-.053	.958	-.007	-.056	.956	-1.967

a. Dependent Variable: Mat5_Eval_Motivation

Coefficients[a]

Model		95% Confidence Interval for B	Correlations		
		Upper Bound	Zero-order	Partial	Part
1	(Constant)	16.328			
	Organization Size	1.566	.010	.010	.010
	Business Classification	1.861	-.007	-.007	-.007

a. Dependent Variable: Mat5_Eval_Motivation

Program Maturity Factor 6 – Infrastructure (Hypothesis 2) Statistical Results

Correlations

		Mat6_ Infrastructure	Organization Size	Business Classification
Pearson Correlation	Mat6_Infrastructure	1.000	.066	.016
	Organization Size	.066	1.000	.037
	Business Classification	.016	.037	1.000
Sig. (1-tailed)	Mat6_Infrastructure	.	.298	.450
	Organization Size	.298	.	.381
	Business Classification	.450	.381	.
N	Mat6_Infrastructure	68	68	68
	Organization Size	68	68	68
	Business Classification	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.067[a]	.004	-.026	8.692	.004	.146	2	65

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat6_Infrastructure

Model Summary[b]

Model	Change Statistics	Durbin-Watson
	Sig. F Change	
1	.864	1.977

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat6_Infrastructure

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.092	2	11.046	.146	.864[a]
	Residual	4911.143	65	75.556		
	Total	4933.235	67			

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat6_Infrastructure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B
		B	Std. Error	Beta			Lower Bound
1	(Constant)	33.261	4.536		7.332	.000	24.201
	Organization Size	1.109	2.110	.065	.526	.601	-3.104
	Business Classification	.286	2.683	.013	.107	.916	-5.072

a. Dependent Variable: Mat6_Infrastructure

Coefficients[a]

Model		95% Confidence Interval for B	Correlations		
		Upper Bound	Zero-order	Partial	Part
1	(Constant)	42.320			
	Organization Size	5.323	.066	.065	.065
	Business Classification	5.643	.016	.013	.013

a. Dependent Variable: Mat6_Infrastructure

Program Maturity Factor 7 – Business Results (Hypothesis 2) Statistical Results

Correlations

		Mat7_Bus Results	Organization Size	Business Classification
Pearson Correlation	Mat7_BusResults	1.000	-.149	.083
	Organization Size	-.149	1.000	.037
	Business Classification	.083	.037	1.000
Sig. (1-tailed)	Mat7_BusResults	.	.113	.251
	Organization Size	.113	.	.381
	Business Classification	.251	.381	.
N	Mat7_BusResults	68	68	68
	Organization Size	68	68	68
	Business Classification	68	68	68

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.173[a]	.030	.000	6.669	.030	1.004	2	65

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat7_BusResults

Model Summary[b]

Model	Change Statistics	Durbin-Watson
	Sig. F Change	
1	.372	2.377

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat7_BusResults

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	89.332	2	44.666	1.004	.372[a]
	Residual	2890.948	65	44.476		
	Total	2980.279	67			

a. Predictors: (Constant), Business Classification, Organization Size

b. Dependent Variable: Mat7_BusResults

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B
		B	Std. Error	Beta			Lower Bound
1	(Constant)	28.349	3.480		8.145	.000	21.398
	Organization Size	-2.014	1.619	-.152	-1.245	.218	-5.247
	Business Classification	1.490	2.058	.089	.724	.472	-2.620

a. Dependent Variable: Mat7_BusResults

Coefficients[a]

Model		95% Confidence Interval for B	Correlations		
		Upper Bound	Zero-order	Partial	Part
1	(Constant)	35.301			
	Organization Size	1.218	-.149	-.153	-.152
	Business Classification	5.601	.083	.089	.088

a. Dependent Variable: Mat7_BusResults

Financial Performance (Hypothesis 4, Hypothesis 5) Statistical Results
Gross Profit Margin (1 of 2)

Descriptive Statistics

	Mean	Std. Deviation	N
Gross Profit Margin	29.4393	17.95748	14
Organization Size	1.57	.514	14
Business Classification	1.21	.426	14
Program Maturity Level	3.7857	.89258	14

Correlations

		Gross Profit Margin	Organization Size	Business Classification	Program Maturity Level
Pearson Correlation	Gross Profit Margin	1.000	-.251	.089	-.374
	Organization Size	-.251	1.000	.101	-.048
	Business Classification	.089	.101	1.000	.130
	Program Maturity Level	-.374	-.048	.130	1.000
Sig. (1-tailed)	Gross Profit Margin	.	.194	.381	.094
	Organization Size	.194	.	.366	.435
	Business Classification	.381	.366	.	.329
	Program Maturity Level	.094	.435	.329	.
N	Gross Profit Margin	14	14	14	14
	Organization Size	14	14	14	14
	Business Classification	14	14	14	14
	Program Maturity Level	14	14	14	14

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.491[a]	.241	.013	17.84011	2.808

a. Predictors: (Constant), Program Maturity Level, Organization Size, Business Classification

b. Dependent Variable: Gross Profit Margin

Financial Performance (Hypothesis 4, Hypothesis 5) Statistical Results
Gross Profit Margin (2 of 2)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1009.426	3	336.475	1.057	.410[a]
	Residual	3182.696	10	318.270		
	Total	4192.122	13			

a. Predictors: (Constant), Program Maturity Level, Organization Size, Business Classification

b. Dependent Variable: Gross Profit Margin

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations
		B	Std. Error	Beta			Zero-order
1	(Constant)	67.688	28.641		2.363	.040	
	Organization Size	-10.059	9.702	-.288	-1.037	.324	-.251
	Business Classification	7.237	11.788	.172	.614	.553	.089
	Program Maturity Level	-8.249	5.602	-.410	-1.473	.172	-.374

a. Dependent Variable: Gross Profit Margin

Coefficients[a]

Model		Correlations		Collinearity Statistics	
		Partial	Part	Tolerance	VIF
1	(Constant)				
	Organization Size	-.312	-.286	.986	1.014
	Business Classification	.191	.169	.972	1.029
	Program Maturity Level	-.422	-.406	.979	1.021

a. Dependent Variable: Gross Profit Margin

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	Organization Size	Business Classification	Program Maturity Level
1	1	3.825	1.000	.00	.01	.01	.00
	2	.087	6.614	.00	.55	.51	.01
	3	.068	7.492	.03	.22	.44	.33
	4	.019	14.076	.97	.23	.05	.66

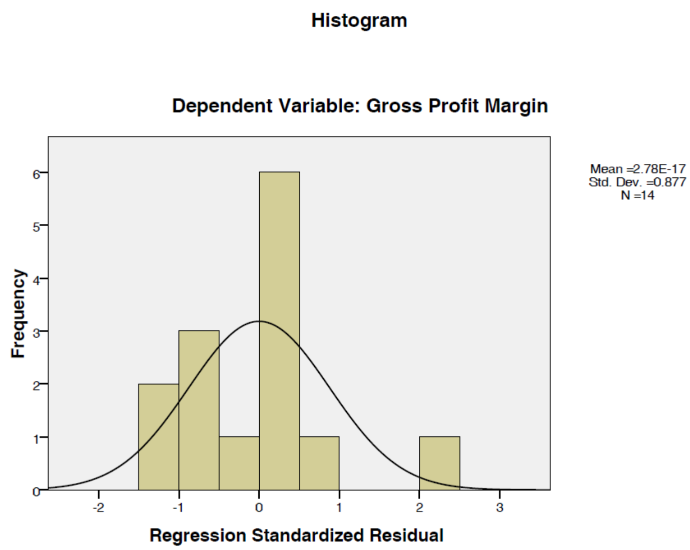
a. Dependent Variable: Gross Profit Margin

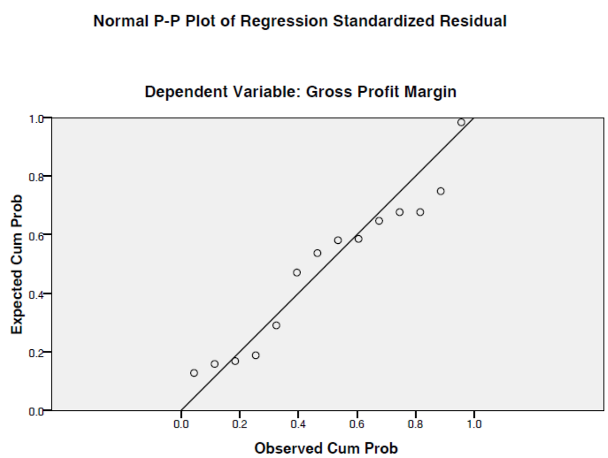
Residuals Statistics[a]

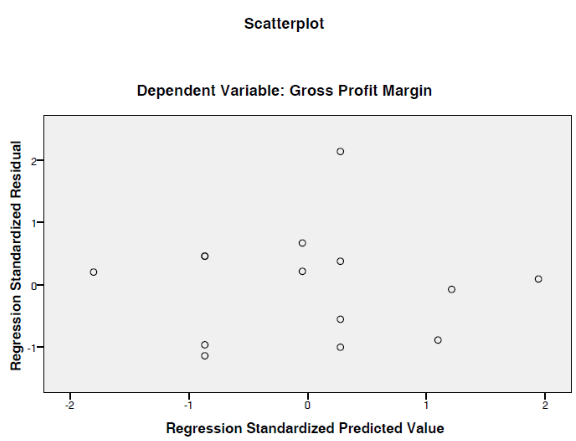
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	13.5604	46.5574	29.4393	8.81182	14
Residual	-20.30961	38.13109	.00000	15.64681	14
Std. Predicted Value	-1.802	1.943	.000	1.000	14
Std. Residual	-1.138	2.137	.000	.877	14

a. Dependent Variable: Gross Profit Margin

Financial Performance (Hypothesis 4, Hypothesis 5) – Charts/Plots
Gross Profit Margin







Financial Performance (Hypothesis 4, Hypothesis 5) Statistical Results
Operating Margin (1 of 2)

Descriptive Statistics

	Mean	Std. Deviation	N
Operating Margin	8.2092	6.67676	12
Organization Size	1.75	.452	12
Business Classification	1.33	.492	12
Program Maturity Level	3.5833	1.08362	12

Correlations

		Operating Margin	Organization Size	Business Classification	Program Maturity Level
Pearson Correlation	Operating Margin	1.000	-.520	-.325	-.007
	Organization Size	-.520	1.000	.408	-.046
	Business Classification	-.325	.408	1.000	-.057
	Program Maturity Level	-.007	-.046	-.057	1.000
Sig. (1-tailed)	Operating Margin	.	.042	.152	.491
	Organization Size	.042	.	.094	.443
	Business Classification	.152	.094	.	.430
	Program Maturity Level	.491	.443	.430	.
N	Operating Margin	12	12	12	12
	Organization Size	12	12	12	12
	Business Classification	12	12	12	12
	Program Maturity Level	12	12	12	12

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.536[a]	.287	.019	6.61150	2.724

a. Predictors: (Constant), Program Maturity Level, Organization Size, Business Classification

b. Dependent Variable: Operating Margin

Financial Performance (Hypothesis 4, Hypothesis 5) Statistical Results
Operating Margin (2 of 2)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	140.675	3	46.892	1.073	.414[a]
	Residual	349.695	8	43.712		
	Total	490.370	11			

a. Predictors: (Constant), Program Maturity Level, Organization Size, Business Classification

b. Dependent Variable: Operating Margin

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations
		B	Std. Error	Beta			Zero-order
1	(Constant)	23.528	10.915		2.156	.063	
	Organization Size	-6.880	4.830	-.466	-1.424	.192	-.520
	Business Classification	-1.850	4.439	-.136	-.417	.688	-.325
	Program Maturity Level	-.227	1.843	-.037	-.123	.905	-.007

a. Dependent Variable: Operating Margin

Coefficients[a]

Model		Correlations		Collinearity Statistics	
		Partial	Part	Tolerance	VIF
1	(Constant)				
	Organization Size	-.450	-.425	.833	1.201
	Business Classification	-.146	-.124	.832	1.202
	Program Maturity Level	-.043	-.037	.996	1.004

a. Dependent Variable: Operating Margin

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	Organization Size	Business Classification	Program Maturity Level
1	1	3.826	1.000	.00	.00	.01	.00
	2	.104	6.061	.01	.02	.39	.37
	3	.048	8.904	.03	.49	.60	.23
	4	.021	13.372	.96	.49	.00	.39

a. Dependent Variable: Operating Margin

Residuals Statistics[a]

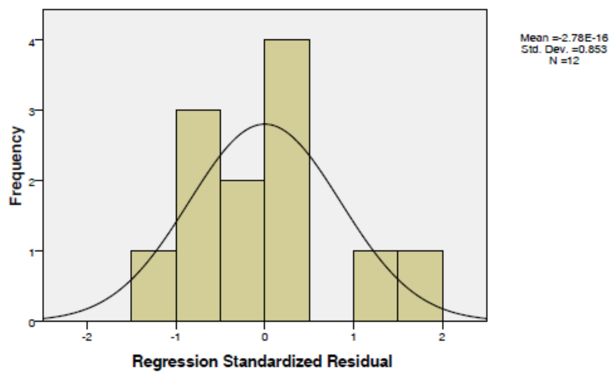
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5.1616	14.1179	8.2092	3.57612	12
Residual	-8.06155	11.83845	.00000	5.63830	12
Std. Predicted Value	-.852	1.652	.000	1.000	12
Std. Residual	-1.219	1.791	.000	.853	12

a. Dependent Variable: Operating Margin

Financial Performance (Hypothesis 4, Hypothesis 5) – Charts/Plots
Operating Margin

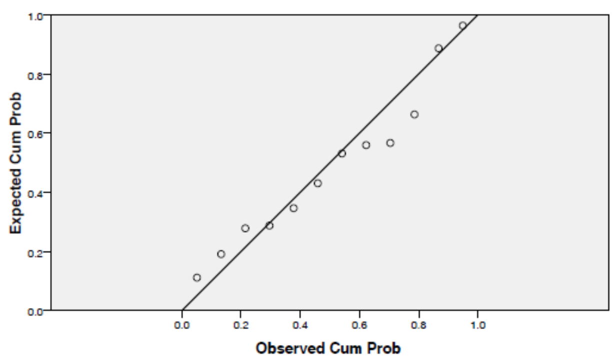
Histogram

Dependent Variable: Operating Margin



Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Operating Margin



Scatterplot

Dependent Variable: Operating Margin